Robt. Entwisle

FIRES IMPROVED:

OR, A

NEW METHOD

OF

Building Chimnies,

So as to prevent their

SMOKING.

IN WHICH

A *Small* FIRE, ſhall warm a ROOM much better than a *Large* ONE made the *Common Way*. And the Method of altering ſuch CHIMNIES as are already Built, ſo that they ſhall perform the ſame Effects.

By Monſieur *GAUGER*.
Made *Engliſh* from the *French* Original.
By J. T. *DESAGULIERS*, L. L. D. and F.R.S.

THE SECOND EDITION,

With an APPENDIX, Containing ſeveral farther IMPROVEMENTS made by the TRANSLATOR and OTHERS.

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SEP

PREFACE.

THE Uſefulneſs of this little *Book* * has induced me to give it the World in *Engliſh*. The Matter contained in it will be entertaining to every Gentleman; and the Manner of reducing it to Practice, eaſily comprehended by the meaneſt Workman. I have omitted whatever I thought ſuperfluous in the *French*, to make way for ſome Obſervations of my own, upon this Subject; that nothing might be wanting to render it of general Uſe.

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* Intitled, La Mechanique de Feu.

Monſieur GAUGER has conſidered only the Improvement of *Wood-Fires*, but I have ſhewn how *Turf* or *Coal* may be burnt in theſe Chimnies, with all the Advantages that he propoſes from his New Conſtruction. He has indeed ſhewn in his *Preface*, that Contrivances are not the leſs valuable, for being ſimple; however, ſome People may admire thoſe only that are the Effect of a great deal of Study, and make a Show with a very complex *Apparatus*. What he propoſes to do by his New Method, is, 1. To light a *Fire* with the greateſt Eaſe, and, if you will, make it *flame* all the time without the *trouble of Blowing*. 2. To make a *Room* very warm with a little *Fire*, which may alſo give *Heat* to another *Room*. 3. To diſperſe the *Heat* ſo uniformly as to take away the uſual Inconveniencies of being obliged to creep near, or to ſit at ſuch a Diſtance from the *Fire*, that we are either *roaſted* before, or *frozen* behind. 4. To make us breathe freſh *Air* conſtantly, which ſhall be of any degree of *Heat* that you would have it, without ever being troubled with *Smoke* or *Moiſture* in any part of the Room. 5. To ſhew how to extinguiſh by one's ſelf, and in a Moment, any *Fire* that ſhould happen in ſuch Chimnies.

Long Experience in his Uſe of the *New Chimney* has confirmed the fore-mentioned Particulars; and what is remarkable, is, that in the ſevere Winter of 1709, when *Water would freeze by the Fire-ſide, almoſt every where elſe, it was not at all frozen in his Cloſet*, tho' expoſed there all Night, and the *Fire* continued no longer than till Midnight.

His Treatiſe is divided into three Books; the *Firſt*, ſhews the Inconveniencies

veniencies of the common, and the conveniencies of the *New Chimnies*.

The *Second*, gives the Reaſons why the *New Chimnies* cannot poſſibly ſmoke.

And the *Third*, which is purely *Practical*, informs the *Workman* in ſuch an eaſy Manner, that they may without any farther Directions perform what is required; in a *more* or *leſs*, ſimple Manner, as any Gentleman ſhall think fit.

Channel-Row, Weſtm.
May 3. 1715.

J. T. Deſaguliers.

Advertiſement.

HIS MAJESTY has been graciouſly pleaſed to grant his Royal Letters Patent to ROBERT PHILLIPS, of *Great Queen Street*, near *Lincolns-Inn-Fields*, for the New Invented MACHINE FIRE-GRATE.

This Invention ſo infallibly prevents the ſmoking of the Chimney in which it is rightly fixed, that the Room will be free from Smoke or any offenſive Smell. The Fire is immediately blown up, and equally ſpreads a gentle Warmth throughout the Room; which may be increaſed or decreaſed at Pleaſure, (as may be obſerved by a Thermometer) keeping the Room warm all Night after the Fire is put out, thereby preventing unwholeſome Air or Smoke coming down from any other Chimney.

In theſe Grates you have the Sight of the Fire; and they are as uſeful, and near as cheap (conſidering their Ornaments) as any other Grate.

By this Method you have both *freſh* and *warm Air*, which is warmed in the ſame agreeable Manner within, as the Sun warms it without; the Rays of Heat paſſing thro', and rarifying it, cauſes it to be as dry and wholſome within, in foggy or wet Weather, as it is abroad in the fineſt Day of Summer; and thoſe who are troubled with the *Phthyſic* breathe in it more freely.

Theſe Machines are fixed in a few Hours, and are of excellent Uſe in large Halls, Hoſpitals, Schools, Green-Houſes, and in all Places where People may have Occaſion to ſit in wet or cold Weather, and to do Buſineſs near a Window, and far from a Fire; a very great Conveniency is, that Rooms are kept free from *Damps* and *Smoke*, by which Paintings and other valuable Furniture are preſerved.

The Approbation they have met with from thoſe who have already purchaſed them, (particularly in the Royal Courts, and at the Houſes of many of the Nobility) is a ſufficient Teſtimony of their Uſefulneſs.

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FIRES IMPROVED.

BOOK I. PART I.

CHAP. I.

Concerning FIRE, *its* Rays *of* HEAT, *and the Way that we are* warmed *by it.*

AS luminous Bodies throw out Rays of Light every way round, ſo does Fire dart out every way *Rays* of *Heat*; for whatever way we come near the Fire, we may be ſenſible of their Impulſe, which gives us a Senſation of Pain when we come too near.

By the *Rays* of *Heat* are meant, the Particles of the Fuel which are darted from the Fire; and are propagated round about, either directly, that is, when they come immediately from the Fire, or by Reflection when they are beaten back from Bodies againſt which they ſtrike; and, as they are reflected, they follow the ſame Laws as the Rays of Light, having their Angle of Incidence equal to that of Reflection.

All Rays of Fire, except thoſe that go ſtrait upwards, whether direct, or reflected, muſt move in a Line, which it is perhaps impoſſible and wholly needleſs to deſcribe: For, as well as the Rays that are darted in an horizontal, as thoſe that are ſent out in an inclined Direction, muſt alſo have a Tendency perpendicularly upwards; becauſe Experience ſhews us, that all little Bodies heated, endeavour to go upwards: Thus in Water or Air, the warmeſt Particles go towards the upper Parts, and ſtill riſe as they are heated. A Ray of Heat then goes on by a compound Motion made up of its Impulſe, according to the Direction which it receives from the Fire, and its conſtant Tendency upwards; ſo that the farther a hot Particle is gone from the Fire, the higher it has aſcended.

The Uſe of this Conſideration will appear in the following Pages.

Fire may give Heat to a Room, and the People in it.

1ſt. By its direct Rays.

2dly. By its reflected Rays.

3dly. By a kind of *Tranſpiration*, that is, when its Heat is tranſmitted thro' a ſolid Body, as in the Caſe of Stoves.

By the Heat of the Fire, is meant, that Motion of its Parts, which cauſes in us that Senſation which is called Heat; and ſometimes Pain, when it is too violent.

In common Chimneys the Fire gives no Heat by *Tranſpiration*; ſends forth but few direct Rays, and fewer reflected ones, as will appear in the next Chapter; but in the Chimneys deſcribed in this Treatiſe, the Fire ſends out more Rays into the Room, and warms much more by *Tranſpiration*, than by its direct or reflected Rays.

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CHAP. II.

The common way of Building Chimneys with the Jams parallel, and the Breaſt inclined, is not proper for reflecting Heat into a Room.

[*Fig*. 1.] SUppoſing the Fire F*f* in a common Chimney AB*ba*, whoſe Sides or Jams AB,*ab*, are parallel to each other, the Ray of Heat *f*G, will be reflected to M; the Ray *f*H upon it ſelf into *f*; the Ray *f*I into N; and the Ray *f*L into P; and as the Ray *f*L going from *f* to L, conſtantly riſes, as it does alſo when after Reflection it goes from L to P, [*Fig*. 3.] it muſt get within the

Flue before it reaches P, and then whereever it ſtrikes againſt *o*R, the fore Part of the Funnel, which is inclined to the Horizon, it will be reflected upwards into the Chimney, always ſuppoſing the Angle of Incidence equal to that of Reflection, and therefore it cannot go into the Room.

[*Fig.* 1.] Thus if we examine all the Rays that fall between H and *a*, we ſhall find that none can be reflected into the Room except thoſe that fall upon the Extremity of the Jam towards *a*; but as they have loſt moſt of their Strength before they can get thither, upon account of their Diſtance from the Fire, they are but very weakly reflected, and therefore give but little Heat; beſides Jams of Plaiſter are very unfit to reflect Heat, by reaſon of their Softneſs and Poroſity.

The Ray *f*H being reflected upon it ſelf to *f*, cannot enter into the Room.

The Ray FG, which is reflected to M. whatever Reflections it undergoes afterwards, muſt neceſſarily go up into the Chimney, and can go out no other way than at the top of the Funnel; the ſame will happen to all thoſe that are reflected between H and B*b*; as alſo to all the Rays which fall from F upon AB; and from this we may judge of the Effect of thoſe which going from any part of the Fire fall upon the Jams AB, *ab*.

[*Fig.* 3.] All the other Rays as FAB, which going from the Fire F, ſtrike againſt the Back, if they have aſcended ever ſo little above the Level of that Part of the Fire, from whence they came before they ſtruck the Back, make a very ſmall Angle with it; and, therefore, after Reflection go up the Chimney, or if any of them, as FGMN, ſtrike againſt the Breaſt *o*R, a ſecond Reflection throws them within the Chimney, where they riſe and are loſt: Therefore ſcarce any but direct Rays which come from the fore Part of the Fire can come into the Room to warm it, and even thoſe muſt come forward in an horizontal, or nearly horizontal Direction; for ſuch as are ever ſo little inclined, riſing as they go from the Fire, are almoſt all got into the Funnel before they have reached the under Part of the Chimney-Piece, as FI, and ſtriking upon the Breaſt *o*R, which is inclined, they are alſo reflected into the Chimney, and become uſeleſs; as for the Rays that go upright, nothing can hinder them from getting out at Top of the Chimney.

Therefore the common way of Building the Breaſt and Jams of the Chimney lets ſo few Rays of Heat come into a Room, as to make the Fire of very little Uſe.

Of late, indeed, Builders have rounded the Corners of Chimneys, covered the Jams or Sides with Plate Iron or Braſs, ſtreightened the Breaſt to make Flats under the Chimney-Piece, carried the Flue or Funnel bending, and by that means have given more Heat to the Rooms; but the Method mentioned in the next Chapter will out-do all that.

CHAP. III.

Parabolical Jams, and an horizontal Plane under the Chimney-Piece, are the fitteſt for reflecting Heat into a Room.

GEometry teaches, that all Rays which coming from the Focus of a *Parabola*, ſtrike upon its Sides, after Reflexion go on parallel to the Axis.

[*Fig.* 2.] If therefore on the back Part of the Hearth of the Chimney AB*ba*, you take the Length C*c*, equal to the Length of the Wood that you would burn, as for Example of 22 Inches; and from the Points C*c* you draw the Perpendiculars CD, *cd*, for the Axis of two half *Parabolas* whoſe *Vertex*'s are C*c*, and A*a* the Diſtance of the Breadth of the Chimney be two Points of the ſaid *Parabolas*; then if thoſe Parabolic Jams AC, *ac*, be covered with Plate Iron, Braſs, or Copper, and *o i m* [*Fig.* 3.] the under Part of the Chimney-Piece be made parallel to the Horizon, and as broad as may be, leaving only 10 or 12 Inches for the Paſſage into the Funnel; I ſay, this Chimney will not only reflect a great deal more Heat than common Chimneys, but as much as any Chimney can poſſibly do.

[*Fig.* 2.] For if F*f* be the two Focus's of the half *Parabolas*, when the Billets, whoſe Length we alſo ſuppoſe F*f*, are on Fire, the Rays of Heat darted from the ſaid Focus's F*f*, which in common Chimneys cannot go into the Room, and ſo are uſeleſs, will here be reflected parallel to the Axis *cd*, to *m*, *φ*, *n*, *p*, and conſequently go into the Room; and thoſe which aſcend forwards at 12, 15, or 20 Inches from the Back, and in the common Chimneys would upon Account of the Inclination of the Breaſt *o*R, [*Fig.* 3.] be reflected inwards, will here ſtrike againſt the Plane *o i m*, which is parallel to the Horizon, and therefore be reflected into the Room: So will the Rays FG*m*, if their firſt Angle of Reflection be ſenſible, and by that means come into the Room towards *n*; and much more the Rays F *i l*, which come directly, and therefore with a greater force from F.

Moreover, tho' the Chimney be as wide as in the firſt Figue, the Jams are much nearer to the Fire, and therefore will reflect more Heat and more ſtrongly; then the Plane *m i o* not only throws back into the Room, the direct Rays as F *i l*, but alſo thoſe that are reflected from the Back, as FG*mn*.

[*Fig.* 2.] If we examine the Rays which come from any part of the Fire between the *Focus*'s of the *Parabolas*, tho' they are not reflected from the Jams in ſuch manner as to go on parallel to the Axis CD, *cd*, yet they will all be reflected obliquely into the Room, as FHI.

[*Fig.* 3.] Some may imagine that the Plane *m i o* being Horizontal, and going ſo near the Back, may cauſe the Chimney to ſmoke; but we ſhall hereafter ſhew that the Effect will be quite contrary.

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CHAP. IV.

Of the Vent-Hole or Bellows; the Reaſon of its blowing, and the Manner of its encreaſing the Heat, and cauſing it to be reflected.

[*Fig.* 2, 3.] IN the middle of the Hearth, at about ten or twelve Inches diſtance from the bottom Plate, muſt be made a Trap-Door Z, that may eaſily open and ſhut, and under it a little hollow Paſſage communicating with the outward Air; when this Trap-Door is lifted up a little way, the Air from without will go out thro' the Paſſage X of the Bellows or Vent-Hole; for there will always be a greater Preſſure of Air from without, than from within the Room, whether the Wind blows, or the Weather be calm; if there be a Fire in the Hearth, becauſe the Heat of the Fire rarifying the Air, and driving part of it up the Chimney with the Smoak, there will be a kind of *Vacuum*, or at leaſt, the Air will be made ſo thin over the Vent-Hole, as to preſs leſs than that which is coming from without; the external Air therefore will ruſh in violently, and not only light the Fire, but cauſe it to flame, even tho' the Wood ſhould be green, and alſo forcibly drive the Flame and Rays of Heat, as FG *mn*, FST, ſo as to make them beat back into the Room after one or two Reflections, when the Fire is lighted.

The Uſe of the Vent-Hole is not only to light the Fire, and cauſe it to flame, but it has ſeveral other Advantages, as will appear in our Second Part. Neither is the Invention of it new; for I my ſelf uſed it five-and-twenty Years ago, having ſeen the Uſe of it in other Places; but then it ſerved only to light the Fire.

N.B. Monſieur GAUGER in his fifth Chapter, only ſhews the way to deſcribe the *Parabolical Jams* of the Chimney, and give Demonſtration of his Method, but it is ſo eaſy to perform this, that we ſhall paſs it over; eſpecially, ſince he refers us to an eaſy way of drawing them nearly *Parabolical*, which you will find in Book III; and in Practice it will do as well as if they were *truly Parabolical*, as they conſiſt of a ſtrait Line and an Arch of a Circle.

This way of making the Jams *nearly Parabolical*, as in *Fig*. 2. and the Plane under the Mantle-Tree Horizontal, as *oim*, *Fig*. 3. will be of little Coſt, and great Advantage to Chimneys already built; eſpecially if the Vent-Hole be added; but thoſe who will add the Contrivance behind the Back of the Chimney, will reap ſeveral other Advantages from it, as will be ſhewn hereafter.

BOOK

BOOK I. PART II.

CHAP. I.

Concerning the ſudden Heat given to the Air; and how the warmeſt Air gets above that which is cold.

AN Experiment or two, made to this Purpoſe, will beſt prove what I affirm.

EXPERIM. I.

I took an Iron Tube of three or four Inches Bore, bended in the manner of a Syphon, and fitting the longeſt Leg of it ſo into the Wall, that the North Wind from without came into it freely; the Air that came into the Room thro' the Hole of the ſhort Leg, was cold enough to freeze Water; but when I laid the ſaid ſhort Leg upon the Fire, the Air ruſhed in thro' the Tube with the ſame Violence as before, and rather ſwifter, and very hot, tho' the heated Part of the Tube was but about a Foot long.

Now a Chimney cannot warm Air after this Manner, and yet appear handſome; becauſe, tho' we ſuppoſe the Back and Jams of it hollow behind, and Plate Iron or Braſs between the Fire and the Cavity; yet Air paſſing thus behind, cannot be ſo heated, as if there was a Fire round it, as in the Caſe of the Tube: But Hollows may be ſo contrived, as to warm a Room in a little Time, how cold ſoever the Weather is, which is all that is required here.

Another Property of the Air is, that the warmeſt Air always gets above the cold. To be certain of it, and know the Difference of Heat, at Top and Bottom of a Room, I made the two following Experiments.

EXPERIM. II.

I hung up two *Air-Thermometers* in my Room, the one at Top near the Cieling, and the other at Bottom near the Floor, and the Liquor aſcended much higher in the upper than in the lower *Thermometer*, tho' it was farther from the Fire than the other; then changing the Places of my *Thermometers*, the Liquor in the upper ſtill would riſe, whilſt that in the lower deſcended. This ſucceeded all the ſeveral Times that I tryed it; and when I took the upper *Thermometer* down to the middle way, betwixt the Top and Bottom of the Room, and took up the lower *Thermometer*, to ſee cloſe to it, the Liquor ſubſided in that which had been the upper *Thermometer*, and roſe in that which had been the loweſt; which ſhews, that in a Room where there is a Fire, the loweſt Part of it is the coldeſt Place, and the higher you go, the warmer is the Air; whence may alſo be concluded, that the lower the Cieling of a Room is, the better it is for warming ones ſelf in Winter.

EXPERIM. III.

Take a Gun Barrel, or any other Iron Tube, open at both Ends, and laying the middle of it horizontally upon the Fire, you will feel a little Heat coming out at each End; but if you lay it aſlaunt, the Air will ruſh out with Force enough to blow out a ſmall Wax Candle at the upper End of the Tube; which will be warm from the Fire to the upper End, whilſt the other Part of the Tube from the Fire downwards will remain cold: Then if you change Ends, ſtill the Air will ruſh out at the upper End, which will be warm, and the lower End will become cold, even tho' it ſhould be the ſhorter End; nay, tho' you ſhould ſtop the lower End cloſe, yet you would feel ſome warm Air come out at the upper End, tho' not with ſo great Velocity as before.

If ſuch a Tube be bent, the Experiment will be much more ſenſible; and, indeed, any one that conſiders how Heat affects the Air, will be convinced that the Thing muſt neceſſarily be ſo; for the heated Air being rarified, becomes ſpecifically lighter than the cold Air, and ſo muſt get above the cold.

N.B. *Whilſt an Oven is heating, and the Flame ruſhing out; any Body may put in their whole Arm near the lower Part of the Oven, without feeling any very great Heat, tho' it be quite otherwiſe as ſoon as the Fire is put out.*

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CHAP. II.

The inner Fabric of the inſide of the Chimneys; how the Air goes into the Hollows, is warmed, and then ſucceſſively warms the whole Air of the Room; how the Air of another Room may be warmed there, and other Advantages of this Contrivance. [*Fig.* 6.]

WE ſuppoſe the whole Compaſs AHC, *cha* of the inſide of the Chimney covered with a Plate of Iron, Braſs, or Copper; and behind it a void Space about four Inches deep, divided by ſeveral Partitions, which form ſeveral Cavities, Cells or ſquare Tubes, the firſt communicating with the ſecond, and the ſecond with the third, and ſo on; making altogether as it were a ſort of a recurved Canal, one of whoſe Ends D muſt be at Bottom, and the other at Top of one of the Jams coming out into the Room; ſo that the Air can go in at the lower End D, and go out at the upper End of it R.

We may alſo ſuppoſe the under Part of the Hearth hollow, and covered with Plate Iron; nay, and the under Part of the Chimney-Piece likewiſe hollow, like a Pipe; ſo that all the Cavities behind the Back, Jams, under the Hearth and

Chimney-Piece altogether make the forementioned winding Paſſage.

We ſhall in the Third Book determine the different Bigneſs, Contrivance, and Situation of thoſe Cavities, and how to fit them to larger or ſmaller Rooms; but their Effects we ſhall ſhew in the following Chapters; we are only now to take it for granted, that the Fire made in the Hearth, can warm ſome one of the Surfaces; of each of thoſe communicating Cavities.

Now ſuppoſing this Paſſage for the Air behind the Chimney; as ſoon as a Fire is made, it will warm the whole Compaſs of the Chimney, the Hollow under the Hearth and the Bottom and Backſide of the Paſſage under the Mantle-Tree (if there is one) and conſequently the Air within the Hollows that thoſe Surfaces ſhut up, and the cold Air, which will come at the lower Entrance D, will begin to grow warm in the firſt Cavity; then as it comes thro' the ſecond, its Heat will increaſe, ſtill it will grow hotter in paſſing thro' the third, *&c.* ſo that it will come out very warm, thro' the upper Hole R or *r*

As long as there is any Fire in the Room, there will by this means be a conſtant Circulation of the Air, thro' thoſe warm Hollows, becauſe the Air in them being rarified, will be ſucceeded by the more denſe; and therefore ſtronger Air which comes in at the Bottom D, and having received a great Degree of Warmth in going thro' all the Hollows, it goes out at R, and gets to the upper Part of the Room, the cold Air all the while coming down and ſucceeding at D, till the whole Air in the Room has paſſed thro'; which it may do, till it has acquired what Degree of Warmth you pleaſe.

The Advantage of thoſe Cavities, conſiſts in the long Journey of the Air thro' them; for if there was only one great Hollow, the Air could not have Time to receive a ſufficient Degree of Heat, eſpecially if it came in from without Doors.

Not only the Air of the Room, in which the Fire is, may be warmed by ſuch a Circulation; but if you bring in the Air from another Room (in which there is no Fire) thro' ſuch a Channel, ſo that it may come from the lower Part of it, and go into the Hole D, a large Pipe alſo going from R to the upper Part of the ſaid Room, after a few Circulations, it will be ſufficiently warmed: Which will be of no ſmall Advantage in ſeveral Caſes.

This Way of warming a Room, gives Heat to all the People in it, tho' at a Diſtance from the Fire; keeps every Place dry, ſtill leaving the Moiſture that it had, or gets in circulating thro' the Room, in the Cavities behind the Fire: So that no Moiſture, even in the greateſt Thaws, can Damage the Goods in ſuch a Room.

When the Air of the Room is ſufficiently warmed, you may hinder it from receiving any greater Degree of Heat, without putting out or diminiſhing the Fire, if you ſhut up the Hole R, where the warm Air comes in.

If you ſhould only ſhut up the lower Orifice D, warm Air would ſtill continue to go out at Top, but in a ſmaller Quantity, as we ſhewed in the foregoing Chapter, that it would go out at Top of the Iron Tube, tho' it was ſtopped at Bottom; becauſe as the warm Air went up, cold Air would go in its Room to the Bottom, and ſo a conſtant Circulation of it would be made there.

CHAP. III.

After what Manner the abovementioned Cavities may be made uſe of for warming a Room, by letting in the external Air through them, tho' the Air be never ſo cold; the way that ſuch Air goes into the Room, how it warms it, and the Manner of knowing in what Time it will be ſufficiently warmed, how it may ſerve to encreaſe or diminiſh the Warmth, without encreaſing or diminiſhing the Fire. [*Fig.* 6.]

IF the outward Air be brought into the Cavities behind the Chimney, by carrying on a Communication from the Hole D, quite out of the Houſe, the Room may alſo be warmed, and ſooner, as well as to better purpoſe, than when we only cauſe the Air in the Room to circulate; for in the firſt Caſe, the Air that goes out of the Hollows after it has acquired a Degree of Warmth in paſſing thro' them, warms the cold Air of the Room, only by mixing with it, and communicating ſome of its Heat to it; and as the warm Air that goes out every Moment is but in a ſmall Quantity, in Compariſon to that which fills the whole Room, a conſiderable Time muſt be taken up, before all the Air in the Room is ſenſibly warmed, eſpecially when the

Weather is very cold, and the Chamber is very large; for that Air does not go thro' very faſt: But it is quite otherwiſe when we make Uſe of the external Air; for beſides that a great Quantity will then go out in the ſame time, thro' the Hole R or *r*, becauſe it goes quicker, as it is always more preſſed from without, than from within the Chamber (as we have already hinted.) This is not only done by this warmed Air, bringing its Heat into the Room, and warming the People in it; but by its driving out the cold Air, and ſucceeding inſtead of it. And that is performed in the following Manner.

The warmeſt Air always riſes above that which is colder, and therefore the outward Air, which comes into the Chamber, after it has paſſed thro' the Cavities of the Chimney when there is a Fire, becoming warmer than the reſt of the Air in the Room, gets above it quite to the Cieling, and ſo much Room as it takes up, ſo much of the cold Air below is driven up the Chimney, as being the only way that it has to get out at; and, therefore, after the Fire has been lighted ſome time, all the Air that was in the Room, before the Fire was made, has been driven away up the Chimney, by the Puſh of the external Air, which comes in warmed. Now, ſince in Time all the cold Air will be gone out of the Room, it may be required to know in how long Time that will happen; which may be found after the following Manner.

[*Fig.* 6.] If a Piece of Paper P hangs from the Cieling by a Thread, over-againſt the Hole *r*, thro' which the warm Air comes into the Room, that Air will drive the Paper before it as it comes into the Room: Now if the Paper be driven two Feet in the fourth Part of a Second, the Hole being ſix Inches Square, then will more than two cubic Feet of Air come into the Room, in one Second; for as the Air ſpreads every way, as it comes out of the Hole *r*, it will puſh with leſs Force againſt the Paper, the farther the Paper is from the Hole; thus if more than two cubic Feet of Air come into the Room in one Second, about 125 ſquare Feet will go in during the Space of a Minute, if the Velocity with which the Air ruſhes in, be ſuch as we ſuppoſe it; but it is always greater, if the Wind blows ever ſo little.

Now if we ſuppoſe the Contents of the Room to be 2000 ſquare Feet; then in 15 Minutes, or a quarter of an Hour, as much Air as it can contain, will have entered into it; and two or three Times more if its Velocity, or the Hole *r*, be greater than we at firſt ſuppoſed.

Nevertheleſs, we muſt not conclude, that all the cold Air which was in the Room, is abſolutely gone out of it; for ſome of the hot will mix with the cold that goes out up the Chimney, but we are at leaſt certain, that the greateſt Part of the cold Air is gone out, and therefore, that the whole Air will in a Quarter of an Hour be very much changed, and well warmed, and that in Half an Hour it will be wholly changed. Not that the Air which remains in the Room after that Time, is as hot as the Air which comes into it from the Hollows, becauſe as this Air comes out, and goes up towards the Cieling, it paſſes thro' Air colder than it ſelf, and therefore as it warms it, it muſt loſe of its own Heat; but then as the Room grows warmer, this entering Air loſes leſs and leſs of its Heat every Moment, becauſe, as well the Cavities, as the Air in the Room, are more and more warmed; and therefore in a Quarter of an Hour, or Half an Hour's Time, the Heat will be ſufficient to warm every Body in the Room.

Air coming this way into a Room, not only drives out the cold Air, but hinders it from coming in under Doors, or, thro' Caſements which don't ſhut cloſe, or at leaſt, from coming in ſo faſt as uſually; for the Room being always full, the external Air meets with more Reſiſtance, and that little which may come in, enters with leſs Force, and mixing it ſelf with the warm Air as it comes in, is heated before it can reach the People in the Room; and, therefore, can no way be troubleſome to them, unleſs they are too near the Doors or Windows. Nay, every Crack or Paſſage in a Door or Window, and every little Cranny may be ſtopped up cloſe without fear of the Room ſmoaking; whereas, when Chimneys are built the common way, ſometimes the external Air muſt be let in at the Door or Window to keep the Chimney from ſmoaking.

[*Fig.* 6.] There is indeed an Inconveniency, which is, that warm Air entering continually, will at laſt make the Room too hot; but this is eaſily remedied by ſtopping up the Hole *r*, where the hot Air comes in; but then as there would no longer be a Circulation of freſh Air, it is better to have a direct Communication with the external Air near R or *r*, the Place where it comes out after it is heated in the Hollows. Thus you may ſometimes have hot, and ſometimes cold, and ſometimes temperate Air, in what Proportion you pleaſe, by opening ſometimes one Hole, ſometimes the other, and ſometimes both. We ſhall in the third Book give the Method of doing this conveniently.

If any one would have the warm Air that comes into the Room, to fall with all its Heat on their Hands or Feet, to warm them in a little Time, and keep them warm at any Diſtance from the Fire, they may eaſily do it, by ſetting one End of a Tin or Paſtboard Pipe, at the Hole R or *r*, where the warm Air comes in, and the other End near the Part which they would warm: Such a Pipe may be carried into a Bed, and warm it to any degree, by diſcharging its heated Air into it; and as ſuch a Tube takes up but little Room, the Bed may be warmed whilſt any Body is in it, and the warm Air may be thrown upon any Part of the Body, ſo as to warm it as long as you pleaſe, which will be of great Uſe, eſpecially in ſome Diſtempers, where it is required to apply warm Napkins conſtantly to a Patient; thoſe that can get no Heat in Bed in hard Winters, may be thus warmed.

The Circulation of the Air of the Room might ſerve for thoſe Uſes, but very weakly, for Reaſons before ſhewn; neither will it be ſo proper as this way, for keeping the Goods in the Room from Moiſture.

CHAP. IV.

To ſhew that when a Room is warm'd by Air which is conſtantly new, it will defend us againſt ſeveral Inconveniences, and eſpecially the Ladies; that it is of great Advantage to ſick People, and thoſe which viſit them.

TO be ſoon and agreeably warm'd by External Air brought into a Room after the above-mention'd manner, is not the only or the greateſt Advantage reap'd by our new Invention; for as well the Inconveniences of a great Fire, as that of extreme Cold are remov'd. The larger Particles of the Fuel darted out againſt us, when we have too large a Fire, or when we are too near the Chimney, burn and dry up the Lungs, and ruin the Eyes, as may be perceiv'd by their Pain and Redneſs; ſpoil the delicate Skin of the Ladies, hurt the Eye-lids, and deſtroy the fineſt Complexions; all which Evils are prevented by the Uſe of the new Chimneys.

As for ſick People, they may be look'd upon as abſolutely neceſſary; for the corrupted Breath of Patients, the ill Humours which go out of their Bodies by Tranſpiration, Particles from their Phyſick, and their Excrements mixing with the Air that continues always the ſame (becauſe we dare not in cold Weather open any Place to let in freſh Air) vitiate the Air more and more; and the Patient has the Infection of the Air to ſtruggle with, as well as his Diſtemper; which often occaſions the Death of thoſe that are ſick, and ſometimes that of ſuch as viſit them pretty much.

Now if freſh Air from the Hollows of the Chimney be let into the ſick Man's Room, of what Degree of Heat is thought moſt proper, it will drive out the corrupted Air, and ſo take off all the Inconveniences which muſt neceſſarily be occaſion'd by Air impregnated with too many poiſonous Particles. Beſides, ſince we can give the Patient what Degree of Warmth we pleaſe, there will be no need of loading and choaking him up with Blankets after the uſual Manner.

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CHAP. V.

External Air thus introduc'd, can be of no ill Conſequence; but, on the contrary, is very proper for Health.

SOme perhaps may be apprehenſive that warm Air is unwholeſome, which I grant of very hot Air, eſpecially when its heat proceeds from a Mixture of heterogeneous Bodies, as Parts of the Fuel from a very great Fire, and as it is found in Air heated by Stoves; but the caſe is different where you have temperate Air, that changes continually; it is the fitteſt for Winter, or at leaſt the moſt wholeſome. This Experience and Reaſon will eaſily ſhew: It is not only certain, that the Air becomes temperate and purer, by paſſing through the Cavities of the Chimneys; but it is to be obſerv'd, that cold Air takes from us part of the Heat that is required to keep us in Health, and its Particles are ſo rigid, that the Motion which the Heat of our Bodies can give them, makes 'em ſtrike ſo forcibly, as, in ſome meaſure, to break the Continuity of our Parts, by tearing our Fibres, and eſpecially damaging our Lungs, (into which the Air ruſhes continually,) and ſo cauſing ſeveral Diſtempers.

'Tis obſervable, that if after a Froſt the Sun ſhines pretty warmly on Flowers, that Heat gives ſuch a Motion to the rigid cold Particles that were fix'd on the Flowers, as to tear and blaſt them. This we our ſelves are ſenſible of, when coming out of the froſty Air, we approach too near the Fire; for then we feel a ſharp Smarting from the ſudden Motion of the frozen Particles of Water, which ſometimes proves very fatal, in cauſing the Loſs of Limbs; but if we are gently warm'd, theſe ſmall Iſicles will be melted, reduc'd to Globules, and ſo blunted, as to be unable to hurt us when their Motion is increas'd by a greater Degree of Heat.

CHAP. VI.

That ſuch as make uſe of Rooms warm'd after our Method, are leſs apt to catch cold when they go out.

SOme People have objected againſt the uſe of our new Chimneys, that going out of a warm Room into the cold Air, would make one apt to catch Cold; but Reaſon and Experience will ſhew the contrary: Do we not every Morning get out of a warm Bed to go into the Cold, and put on Cloaths much leſs warm than the Bed? It is a Miſtake to imagine in common Caſes, that People that are us'd to great Fires, catch Cold when they go into the Air, upon account of the Warmth of the Room which they come out of: It is rather the Cold which they feel in the Room, when one part of the Body is cold, whilſt another is almoſt burn'd. The irregular way of warming ones ſelf, occaſions thoſe Inconveniences. When the Warmth is regularly communicated to the whole Body, it is much longer retain'd: A Perſon warm'd by our Chimneys, will be in the ſame Condition, as thoſe that ſlide, ſcate, or uſe any other violent Exerciſe in froſty Weather.

It is about nine or ten Years ſince I firſt us'd this new Contrivance, and I have not once catch'd Cold ſince, tho' I us'd to have a Cold two or three times every Winter before. The *Danes*, *Germans*, and other Northern People, who make uſe of Stoves, wonder at our way of warming our ſelves in Winter, ſaying, that either we ſit in the Cold to ſee Wood or Coals burn at a Diſtance, or elſe, by coming near the Fire, add the Pain of Scorching to that of the pinching Cold. They eaſily bear with the ſmothering Heat of Stoves, to avoid the other numerous Inconveniences of an hard Winter; which our Chimneys wholly take off, without troubling us with any of the ill Qualities of Stoves.

CHAP. VII.

That a little while after the Fire is kindled, the External Air gives Heat to the Room, tho' it feels as if it were cold when it comes in. [*Fig.* 6.]

IN very cold Weather, as ſoon as you begin to kindle the Fire, the External Air paſſing only thro' very cold Cavities, muſt needs cool the Room as it comes in; therefore one might, during ſome Moments, ſhut up the Hole R where it comes into the Room, till the Fire burns, and the Hollows are a little warm'd; but then there would be ſome Danger of being troubled with Smoke whilſt that Hole was ſhut up, therefore in ſuch a Caſe it is better to leave it open, and blow up the Fire as ſoon as may be, for the bottom Plate will be immediately warm'd as ſoon as it beats againſt it; and then the Air which comes thro' the Cavities, tho' it feels cold as it comes into the Room, will not only not cool it, but even warm it; and the ſame Air when it feels temperate, will give more Heat than the Air of the Room made to circulate, tho' this laſt feels very warm; ſeveral Experiments have convinc'd me of the Truth of theſe two Paradoxes, ſome of which I ſhall give here.

EXPERIM. I.

The Fire being kindled in my Room, I found that my Thermometer roſe whether the Hole R was ſhut or open, which is a Sign that the Room is not cool'd by the Admiſſion of this new Air from without, tho' it feels cold as it comes in.

REMARK.

For the right Underſtanding of this and the following Experiments, it is to be obſerv'd, that beſides the general Cauſe of Cold, which is the Reſt of the Parts, the Coldneſs of the Air proceeds ſometimes from the Quality of its Parts, ſometimes from their Determination, and ſometimes from both together.

1*ſt.* The Coldneſs of the Air proceeds from the Quality of its Particles; as when they are rigid, frozen, and almoſt without Motion, or at leaſt mix'd with watery Particles that have thoſe Qualities, as it happens in Winter, in a hard Froſt, when the Wind blows but little; this Sort of Cold acts ſtrongly on all it reaches, eſpecially inanimate Bodies, as Rivers, Trees and other Plants; much more than when there is a Wind. It cauſes a Smarting alſo in Animals, for then the pointed Particles, like ſo many Needles, penetrate farther then the outward Skin.

Theſe Particles, mix'd with the Air, make the Cold ſo ſenſible in the Morning when the Sun riſes, after a froſty Night, eſpecially if there be a hoar Froſt upon the Ground; for then the Sun raiſes thoſe ſtiff Particles before he has blunted or melted them, and they fix on whatever they meet with, entering into the tender Parts of our Bodies, and ſo give us a more vivid Senſation of Cold, than any Cold in the Night-time.

2*dly*. The Coldneſs of the Air proceeds from the Determination of its Parts, when they have been violently driven the ſame way. Thus fanning, blowing with Bellows, or ſtrongly with our Mouths, makes that Air feel cold or cool, which is otherwiſe warm; but this ſort of Cold is only ſuch, in reſpect to our ſelves; it is not communicated to inanimate ſolid Bodies, nor even to Liquids when they are ſhut up in Veſſels; this is the reaſon why the ſame Air that appears cold to us, does not cauſe the Liquor of the Thermometer to deſcend in the foregoing Experiment. Here follows another Experiment, which I have often made with the ſame Succeſs.

I have for a long time together, with a Pair of Bellows, blown on the Balls of two different Thermometers, whoſe

Liquor has conſtantly riſen, tho' it felt cold to my Hand as it came out of the Bellows. The Air was drawn into the Bellows near the Thermometer, and the Liquor would riſe moſt when the Weather was very cold, and the Liquor was but a little height above the Ball, before I began to blow.

Setting a long Tube to my Mouth, I blow'd upon my Hand, and the Air felt cold; but when I blowed upon the Thermometer, the Liquor would riſe: If the Tube was added to the Noſe of the Bellows, the Air would feel colder when it came out, than if I blow'd with the Bellows only; but then the Liquor in the Thermometer would ſtill riſe, tho' not ſo high as when blow'd with the Mouth, becauſe in the laſt Caſe the Air was heated in paſſing thro' the Lungs.

3*dly*. The Coldneſs of the Air is occaſion'd both by the quality and determination of its Parts; when thoſe Particles being frozen or mix'd with frozen watery Particles, and each of them ſingly, being almoſt void of Motion, they are altogether carried in a right Line, as it happens in Winter during the great Winds, eſpecially thoſe that blow from the North: And Cold of this Nature is always more ſenſible than when it proceeds only from the Determination of the Parts. The

Difference between the Action of Cold Air upon animate and tender, or inanimate and inſenſible Bodies is this; That when Air loaded with the abovemention'd pointed Particles is driven violently againſt our Bodies, the cold ſharp Particles are driven into our Fleſh, and affect us ſtrongly; but when they ſtrike upon hard Bodies, they paſs over them, without fixing to them, as we may often find that there is a harder Froſt when the North Wind is leſs, than when it is more violent. On the contrary, when hot South Winds blow hard, they cauſe in our Bodies a Senſation of Coolneſs; but feel hot when they blow but very gently, tho' the Thermometer riſes as much in the firſt, as in the laſt Caſe; but this will be farther explain'd when we conſider the third and fourth Experiment.

EXPERIM. II.

I found that when the External Air had paſs'd thro' the warm'd Cavities behind the Chimney, tho' to the Feeling it was but of a moderate Heat, it warm'd the Room more, and caus'd the Liquor in the Thermometer to riſe higher than the Air of the Room, when circulating thro' the ſame Cavities, it felt much hotter as it came out at the Hole R.

One of the Reaſons of this Phænomenon, is the Direction of the Parts of the External Air, which comes in with a great Swiftneſs, and ſo (for the Reaſons given in the foregoing Remark) cauſes a relative Cold only.

A ſecond Reaſon is, That the External Air comes into the Room in a greater Quantity than the Air taken into the Room, becauſe it comes in ſwifter.

The third Reaſon is, That the Air of the Room, after coming out of the Hole R, only warms the Chamber by mixing with it; whereas the External Air is conſtantly driving out the cold Air.

The fourth Reaſon is, That the Air from without coming in very faſt, keeps the Room always full, and ſo hinders the cold Air from coming in under Doors, or thro' any Crannies.

The laſt Reaſon is, That when the Air conſtantly comes in from without; you have always more denſe Air in the Room, it being more preſs'd; ſo that any Body that is heated, has a greater Quantity of this warm Air about it, than it would have of other Air of the ſame Degreee of Heat, and therefore is acted upon by more Particles of Air in Motion, which muſt conſequently communicate more Motion to its own Parts.

EXPERIM. III. [*Fig.* 6.]

The Fire being lighted, I have often held the Ball of my Thermometer at the Hole R, where the External Air comes in, and it never ſunk there, tho' it often roſe; but if I open'd my Window, and held the Thermometer near it, the Liquor would ſubſide conſiderably.

The Reaſon of this appears to be, that the External Air was only cold by the Determination of its Parts; but the Air that came in at the Window, was colder by the Quality of its Parts (for it froze then) than by their Determination; ſo that it muſt then cauſe the Thermometer to ſubſide, and would have cooll'd the Room very much, if it had been let in then, as we have explain'd elſewhere.

EXPERIM. IV. [*Fig.* 6.]

Holding the Thermometer to the Hole R, when the External Air came into the Room, ſo as to be lukewarm to the touch, and then holding it to the ſame Hole, when the Air taken from within the Room comes out, ſo as to feel very warm; I found the Liquor to riſe no higher in this laſt Caſe, than in the firſt; becauſe the External Air felt only colder, upon account of the Determination of its Parts; and coming out in greater Quantity, more Parts of it encompaſs'd the Ball of the Thermometer, and more fine Ethereal Particles were driven into the Liquor.

From the foregoing Obſervations and Experiments, we may conclude, that the External Air need not come very hot into the Room to warm it; if it be temperate, it is enough.

That we are not to judge of Heat or Cold only in reſpect of our ſelves; becauſe that kind of Cold which affects us moſt, does not affect inſenſible Bodies ſo much; and ſo on the contrary.

That it is a Miſtake in thoſe who would be affected with the ſame Degree of Heat, to have their Room juſt ſo hot as to keep the Thermometer at the ſame Degree; becauſe they ſhall be differently affected, according to the greater or leſs natural Heat of their Bodies at that time.

Moſt People have obſerv'd, that the Air in Cellars feels warm in Winter, and cold in Summer; but it is only comparatively ſo, for the Thermometer ſtands at the ſame Height in deep Cellars at both Seaſons: This I have commonly obſerv'd, but in very cold Weather, as for Example, In the Winter of 1709, the Liquor ſubſided to 18 Degrees, which was two Degrees below *Froſt*; tho' the Air did not feel cold in the ſaid Cellar, and in a hot Summer it has riſen up to 60 Degrees, tho' then it felt cold.

To give a plain Experiment, which any Body may make; Let any one, having one Hand cold, and the other hot, cauſe lukewarm Water to be pour'd on both his Hands, and it will appear cold to one Hand, and hot to the other; ſo that we muſt judge of Heat and Cold as they are agreeable to our Bodies, and not as thoſe Qualities affect inſenſible Objects. Therefore, tho' by the Thermometer the Air of our Room appears of a ſufficient Degree of Heat; yet, if it feels cold to us, we muſt increaſe its Heat.

The Reaſon why Air, otherwiſe warm, feels cold when blown briskly on any part of the Body, ſeems to be that by its violent Motion, it beats away thoſe warm Particles about the Surface of the Parts, which cauſes the Heat of our Bodies by their Motion, or rather ſtops their Motion by its Preſſure, as we may ſee ſuch an Effect produc'd when we cool hot Coffee by blowing upon it. Now in the Caſe of the Thermomoter, the Glaſs ſtops all the groſs Air, and only ſome very fine Particles paſs into the Liquor thro' the Glaſs, and having more Motion than the Parts of the Liquor, cauſe it to dilate and riſe; ſo when the Hand is blown on, if a Glaſs be interpos'd between, we no longer feel the Cold; and if our Senſe of feeling was nice enough we might feel a Warmth.

After the ſame Manner, tho' the cold External Air grows warm as it comes thro' the Cavities of the Chimney, yet it muſt feel cold (when the Fire has not been in long,) as it comes into the Room at R; becauſe not having yet acquir'd a Motion capable of giving us the Senſation of a moderate Heat, it affects us as blowing would do; but then when it is got a little way into the Room, it ſpreads and loſes that Power which it had at firſt coming out of the Hole, thro' the confin'd Paſſages of the Chimney: So that unleſs the People in the Room are, during the lighting of the Fire, ſo near the Hole R, as to receive the Percuſſion of the Air, whilſt its Direction is ſtill in a right Line, they will not be cooll'd by it. Now, beſides this, we are to obſerve, that this Air drives out the cold Air of the Room as it comes in, and cauſes the Thermometer to riſe.

BOOK I. PART III.

CHAP. I.

Concerning the Make of the Funnel of the Chimney, for increaſing and retaining the Heat. The Manner of putting out the Fire, that might catch in the Funnel, in an Inſtant, and how to make the Room continue warm after the Fire is out. How the Hole of the Funnel at Top of the Houſe muſt be ordered, that the Heat of a Room may be encreas'd.

THE Winds that often blow down the Funnels of Chimneys into Rooms, ſhould have made Builders take this Matter into Conſideration; for when the Air of a Room comes to be pretty warm, there are at leaſt two Columns in the Chimney, one of riſing Smoke, and the other of deſcending Air; and tho' the Air does not always deſcend ſo violently, as to make little Whirl-winds in the Chimney Corners, or as to blow the Smoke down into the Room, as it often does when the Wind is very high; yet it always comes down faſt enough to cool the Room. It is true, ſuch Chimneys very ſeldom ſmoke; but then a Fire in them does little Good in very cold Weather. To avoid this Inconveniency, the outward Hole of the Funnel ought to be ſmall, always leſs than the Bore of the Funnel, and ſhould have ſeveral Diviſions to cut the Wind. Some have, indeed, ſtreighten'd this Paſſage, but it has been only to hinder the Room from ſmoking; in which Caſe it commonly proves ineffectual, unleſs with the Contrivance about it, which we ſhall ſhew in the next Book.

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CHAP. II.

How to put out the Fire in the Funnels of Chimneys in a Moment, and to retain the Heat in a Room all Night long.

OUR new Chimneys, indeed, are leſs apt to catch Fire than others, becauſe they gather leſs Soot; but ſince that may happen thro' Careleſneſs, we muſt ſhew how to remedy ſuch an Inconveniency.

[*Fig.* 4.] To be able by oneſelf to put out ſuch a Fire in an Inſtant, we muſt have a Regiſter Plate of Iron towards the

Top of the Funnel, ſo fix'd by two Wires, as either to ſhut up the Paſſage wholly, or to leave it open, as you pleaſe; and ſuch another towards the Bottom of the Funnel, as we ſhall ſhew in their Deſcription in the Third Book.

When the Chimney is on fire, we move the Coals out of the Hearth, and by means of our Wire, pull down both the Regiſter Plates; then the Smoke and Air confined betwixt them, will ſo preſs upon the burning Soot, as to put it out quickly.

The Fire in the Funnel might be put out by pulling down only the upper Regiſter Plate; but then the Smoke would come into the Room, till the Fire was out, which, however, might be borne with, rather than run the Hazard of letting the Fire burn long in the Funnel.

If there was no Regiſter Plate at the Bottom of the Funnel, to avoid the Smoke, you ſhould hang a wet Cloth before the Chimney, and, inſtead of taking out the Coals, throw Water upon them, and then pull down the Regiſter Plate at Top: And, when the Fire of the Funnel is quite out, the Regiſter Plates muſt be reſtored to their Vertical Poſition, that the Smoke may freely come out, when the Fire is again lighted on the Hearth.

Theſe Regiſter Plates will ſerve to keep in the warm Air, and keep out the Cold, in the Night-time, by ſhutting down either of them; but then you muſt put out all the Coals, but ſuch as do not ſmoke, if you have a mind to leave any Fire. Another Conveniency will be, that you will hinder the Smoke of another Chimney from being beaten down into your Room.

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CHAP. III.

Of what Uſe the Aſh-Hole, and the Inſtrument to cover the Fire is, in order to preſerve the Heat in the Night-time.

IF you have an open Cavity in the the middle of the Hearth, towards the Back of the Chimney, about an Inch deep, it will ſerve to hold the Aſhes that fall from the Fire, and thoſe Aſhes, at Night, being thrown upon the Coals, the whole Hearth will be kept warm in the Night-time; as alſo the Cavity under the Hearth (if there is one) through which you may let the Air of the Room circulate, ſtopping the Paſſage of the external Air; becauſe we now ſuppoſe the Regiſter Plates in an horizontal Poſition, and in the Morning you will find the Room ſtill warm, how cold ſoever the Weather is. Another Way is, to cover the fore-part of the Chimney, that the cold Air may not come in, or the warm go out, all the Time.

If you uſe an Inſtrument of Copper, Braſs, or Plate Iron, made like a Box without a Lid, ſo large as to cover all the Fire, the Wood Coals may be put together, and the Iron Box over it and all the Aſhes, and ſo you will have a little Fire ſtill left in the Morning. Thus the Air of the Room will, in its Circulation, keep the Degree of Heat that it has, or acquire a greater; and taking off the *Cover-Fire* (as the Author calls it) the Fire will be eaſily blown up in the Morning, by opening the Vent-hole a little.

BOOK

BOOK II. PART I.

CHAP. I.

Concerning the Advantages of the new Chimneys, in order to hinder the Smoke from blowing into a Room; the Cauſe of which, Builders ſeem not to have underſtood, becauſe hitherto they could not wholly prevent it. Of Smoke, and the Way to hinder it from beating into a Room, by the Make of the Fore-part of the Chimney. What cauſes Rooms to ſmoke; with ſome Reflections concerning Air.

THE Cauſes of the Smoke's being troubleſome to us in a Chamber, are two-fold, Internal or External. The Internal Cauſes, that is thoſe within the Room or Chimney, are, firſt, void Spaces which are often about the Fire, and are occaſioned,

1*ſt*. Becauſe the Air being rarified by Heat, leaves ſeveral Intervals between its Parts, where the Smoke, meeting with leſs Reſiſtance than when they are fill'd, takes up the Place where the Air was before.

2dly, Part of the Air of the Room goes out with the Smoke, and ſince the Fire is conſtantly cauſing freſh Smoke, there will at laſt be ſo much Air gone out of the Room, that the External Air will have more Force againſt the Smoke, than the Air that is left in the Room, and ſo the Smoke will be driven into the Room.

3dly, The Air goes out of a Room, when a Door is open'd into a warmer Place, and then the Smoke, will come back into the Room, upon account of the diminiſh'd Preſſure. The ſame will alſo happen when you open a Door or a Window of any part oppoſite to that where the Wind blows.

This kind of Void that happens in a Room, is the chief Internal Cauſe of its ſmoking, and has not yet been taken notice of, in order to remedy it.

Too great a Quantity of Soot, and groſs Air ſtagnating in the Funnel, when you firſt light the Fire; the common Make of the Jams and Breaſt of Chimneys; and the way that moſt of the Funnels or Flues are carried, are alſo internal Cauſes of a Room ſmoking.

REMARK.

We obſerv'd in the firſt Chapter of the Second Part of Book I. That ſeveral

Experiments ſhew warm Air to be lighter than that which is cold; and therefore there is no doubt, but that Air rarefied by Heat, is ſpecifically lighter than cold Air. Now, ſome have objected, that when the Air in the Room is warm, as it becomes lighter, its Preſſure will be diminiſh'd, and ſo the Smoke will eaſily be driven into the Room; but we muſt conſider, that the Preſſure of the Air in the Room, is help'd by that of the whole Atmoſphere; and tho' the warm Air in the Room, ſhould weigh but a quarter of what the cold Air did before, yet it cannot take off above a ten thouſandth, or twenty thouſandth Part of the whole Preſſure, as may be ſeen by the Barometer, which does not ſenſibly fall, when the Room is very warm; beſides, the Air in the Chimney, which takes up a longer part of the Pillar of the Atmoſphere, is more rarefied by the Fire. Therefore this cannot be the Cauſe of a Chimneys ſmoaking; but the abovemention'd Voids.

The External Cauſes of Smoke; that is, ſuch as are without the Chamber or the Chimneys, are, 1*ſt*. The External Air above the Chimney, which hinders the Smoke from coming out.

2*dly*, The Wind which not only hinders it from coming out, but beats it back into the Funnel of the Chimney, where they alſo blow down ſome times with ſuch Violence, as to drive the Aſhes and Coals about the Room.

3*dly*, The Hole at the Top of the Funnel too large, or too long, for its Breadth.

Air hinders the Smoke from going out at the Top of a Chimney.

1*ſt*. When it is too thick for the Smoke to break thro' it.

2*dly*, When the Chimney is commanded, tho' the Weather be very calm, and the Air clear, becauſe, as the Parts of the Air move every way, the Reſiſtance that they meet with on any one Side, diminiſhes the Spaces between them, and ſo both condenſes the Air, and encreaſes its Spring; then, as in the former Caſe, the Smoke cannot ſo eaſily divide the Air to get up thro' it.

The ſeveral Caſes wherein the Wind keeps back the Smoke, are theſe:

1*ſt*. When Chimneys are commanded on any Side, as when they are near any great Building, near a Steeple, Tower, or a higher Houſe, or the Side of a Mountain, *&c.* they are uſed to ſmoke, tho' the Wind is ſcarce ſenſible, eſpecially when it comes from the Side oppoſite to that which commands them; becauſe the many Stops that it meets with, makes it reſt at Top of the Chimney, and even drive into it by its encreaſed Spring, as we ſee all Fluids go towards thoſe Parts where they are leaſt preſs'd.

2*dly*, When the Winds are violent, this Inconveniency is greater, becauſe ſuch Winds not only hinder the Smoke from going out, but make it go back with Violence; for the Air in the Chimney, whatever Wind blows, is always more rarified than the outward Air. Likewiſe, when the Wind blows very faſt, and has a great Degree of Velocity; and if its Horizontal Direction makes it ſlide over a Chimney's Top, it is becauſe it meets with nothing in its way, juſt as Water that being forc'd out of a Spring along a Table with Holes in it, paſſes along ſuch a Table, without falling down the Holes, whilſt it has no Reſiſtance before it; but if it meets with any rub, it ſpreads all round about, and falls thro' the Holes of the Table, and that eaſier than it would run off on the Sides, by reaſon of its Weight; now rarified Air, or the Smoke, which is in the Chimney, does that to outward Air, which Gravity did to the Water in the Caſe juſt mention'd; that is, when the Wind meets with a rub beyond the Chimney, the Rarefaction of the Air in the Chimney under it, takes off from the puſh upwards againſt the Smoke, which amounts to as much as giving it a preſſure downwards.

3*dly*, When a Chimney is near enough to the Place that commands it, and the Wind is ſtrong, it may be made to ſmoke, tho' the Wind blows from that Part where it is commanded; becauſe the Oppoſition that the Wind meets with, encreaſes the Spring of the Air, and making it to be condens'd in that Place, as ſoon as it is paſs'd over the Obſtacle, it puſhes downwards into the Chimney, where it meets with leaſt Reſiſtance.

4*thly*, Tho' a Chimney is not commanded, the Wind may blow into it, eſpecially, if its Hole be a *Parallelogram*, and the Wind runs along its longeſt Sides; and indeed in any Poſition of the Hole, a North Wind, which commonly blows downwards, may beat into it.

Laſtly, Too wide a Hole at top of the Funnel; becauſe the Wind may eaſily blow into it then. Theſe are Cauſes of a Room's ſmoking; and we ſhall ſhew which way theſe Inconveniences may be remedied, when we have made it appear, that the Make of common Chimneys cauſes them to ſmoke.

CHAP. II.

That parallel Jams *or Sides, the Inclination of the* Breaſt *or part behind the Mantle-Tree, and the way that the Funnels are carried, occaſion Chimneys to Smoke.* [*Fig* 1.]

IN common Chimneys where the Jams are parallel, the Smoke eaſily ſpreads into the Corners CBA *cba*, and the leaſt Agitation throws it into the Room.

1*ſt*, Becauſe when it is in thoſe Corners, it is leſs puſh'd upwards, as being no longer over the Fire.

2*dly*, Becauſe thoſe Places being leſs heated, the Air of the Room is not driven ſo ſtrongly thither, and conſequently does not ſo much puſh the Smoke.

3*dly*, Becauſe the Air of the Room ſtriking with more Force upon the middle of the Chimney where the Heat is, it becomes more extended by Rarefaction, and puſhing the Smoke ſtill againſt the Corners of the Chimney, makes it recoil and go back into the Room.

4*thly*, Becauſe the Air of the Chamber does ſcarce preſs the Smoke at all, when it is got under the Chimney-Piece; becauſe of the inclin'd Breaſt *o* I *r*, where there is a free and heated Paſſage, into which it goes freely and dilates it ſelf.

5thly, Becauſe if the Air be driven forcibly into the Chimney, as it happens when a Window or a Door is open; that Air driving the Smoke violently againſt the Back of the Chimney, it will be reflected into the Chamber, and if it be driven from thence back into the Chimney, it will whirl about in the Corners, eſpecially if a Wind at the ſame time blows down the Chimney.

[*Fig.* 3.] As for the Breaſt of the Chimney *o* I *r*, it not only gives Paſſage to the Air that ſhould drive the Smoke up the Chimney; but when it is heated, it rarifies the Air in the Space *m i o r*, ſo much as to make it preſs leſs againſt the aſcending Smoke, which therefore ſtrikes near the Slope *o* I *r*, and being reflected, comes back into the Room; for it does not obſerve the ſame Rules as the Rays of Heat; and as it beats upon the Surface *o* I *r*, the greateſt part of it is ſpread every way; as it happens to riſing Liquids that meet with Oppoſition.

[*Fig* 4.] The Smoke is alſo reflected into the Chamber, when Chimneys have their Funnel drawn on their Wing on one ſide; for the Inclination beginning from the Top of the Jam at B, the Smoke DE, which meets with Reſiſtance there, is reflected and comes down ; and that more than it would do if it ſtruck higher at L ; for the Force diminiſhes as it goes farther from the Fire ; but how little ſoever it comes down from ſtriking againſt E, it comes back into the Room. For Experiment-ſake, hold a ſmoking Cole in the Chimney-corner juſt under B, and then in the middle under L, and you will ſee that the Smoke which ſtrikes againſt E, will go back into the Chamber ; but not when in the laſt Caſe it ſtrikes againſt L.

CHAP. III.

That Jams or Sides bent into a Parabolic Form ; the Horizontal Plane under the Mantle-Tree ; and the Funnels carried in Curve Lines, when they are not carried directly up, are the moſt proper for hindering Smoke.

PArobolical Jams, and a Funnel whoſe Wings are bent in a Curve, will take off all the Inconveniences mention'd in the laſt Chapter.

[*Fig.* 2 & 6] For, 1*ſt*, you take off the Corners *cba* CBA, where the Smoke uſed to ſtagnate, and then come back into the Chamber.

2*dly*, This confines all the Smoke over the Fire which drives it upwards with Force; and ſo it has more Power to reſiſt the Air at Top of the Chimney.

3dly, The Air of the Room preſſes againſt the Smoke, whilſt it is over the middle of the Fire, and ſo drives it all at once up the Funnel.

4thly, If any part of the Air that ſtrikes upon the Jams be reflected, it goes to F *f* the *Foci* of the Parabolas, and therefore drives the Smoke thither; where it is carried up by the Action of the Fire.

5thly, As the Air of the Room goes into the Chimney, it meets with a narrower Paſſage, which makes it encreaſe its Force; and much more ſo, by reaſon of the great Rarefaction of the Air, which is directly over the Fire: Likewiſe by reaſon of the Horizontal Plane *o i m*, the Smoke that would come back into the Room, meets with the whole Stream of Air, and ſo is puſh'd up.

6thly, The Air from the Room having gradually more Force as it comes into the Chimney, as ſoon as it has paſs'd *m*, goes with Violence into the Funnel *m* L R and, as it goes up, makes a Wind, which forcibly carries up the Smoke.

[*Fig.* 3.] As for the Horizontal Plane *o i m*, it not only cauſes the abovemention'd Condenſation of the remaining Air, ſo as to make it act more ſtrongly againſt the

Smoke, but alſo fills up the Void *o* M R, which, as we ſhew'd before, was one of the Cauſes of a Chimney's ſmoking; and if any Smoke ſhould eſcape, and endeavour to go out of the Chimney under it, before it can be got from *m* to *o*, it is beaten back by the entring Air, whoſe Force is greater towards *mio*, than lower; becauſe the Air being already warm, and that Surface warming it ſtill more, makes it tend upwards, and ſtrongly preſs againſt *mio*, ſo as to hinder any Smoke from coming out that way.

[*Fig.* 4.] Laſtly, if the Wing be carried in a Curve; as for Example, in the Arc B*e*H, whoſe Center is taken upon the Side of the Plane *mio* under the Mantle-Tree produced, as at C, you will avoid the Diſadvantages owing to the common way of building it in the Line BELH.

For, 1*ſt*, The Smoke DE, which would have ſtruck againſt E, will only ſtrike againſt *e*, and with leſs Force, as well becauſe it becomes weaker, by being farther from the Fire, as becauſe the Surface is leſs inclin'd: Thus if you ſuppoſe the Smoke to ſtrike againſt E, and from it to deſcend to D, whence it will go into the Room; in this Caſe, as it does not ſtrike againſt the Wing till it comes to *e*, it will only be beaten back to E, and conſequently cannot go out of the

Chimney downwards, but will be puſhed up by the Air, and the freſh Smoke that comes from the Fire.

2*dly*, Suppoſing that only part of the Smoke that ſtrikes againſt E, ſhould go down again, and be reflected as uſually, the Reflections will be made to G, and ſo may occaſion the Smoke that is below EG not to riſe ſo eaſily; but when it ſtrikes againſt *e*, it is only reflected to *g*, where it cannot hinder the Smoke that is below it.

You may leave the falling Wing of the Funnel *b p h* as it is commonly inclin'd; but it is better to have it a Curve alſo, as you may ſee in the Figure.

That this way of building Chimneys muſt be a great Means to hinder them from ſmoking, is plain, from what has been ſaid; but if there ſhould be ſome Caſe where it would not be ſufficient, the Method that we ſhall give in the two other Parts of this Book, will fully do it.

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CHAP. IV.

Concerning the Vent-Hole, and the way of laying the Wood in the beſt manner to prevent the Smoke.

THE Bellows or Vent-Hole mention'd in the *firſt Part of Book* I. does alſo prevent Smoke; not by driving it up the Chimney, as ſome imagine (for its Direction would only drive it againſt the Back) but by making the Fire to flame, and ſo diminiſhing the Quantity of Smoke (Flame being only burning Smoke:) As alſo by encreaſing the Heat of the Fire, and thereby giving it more Force to drive up the Smoke. If the Vent-Hole be too long, it will throw about the Smoke, more than it encreaſes the Heat; therefore we ſhall give a particular Deſcription of it in the *Third Book*.

If the Wood be round, then all the Care requir'd is to lay it ſo as the Air may draw eaſily between to fan the Fire; but if it be cleft Wood, you muſt never let the flat Side incline forward towards the Room, but be either perpendicular, or rather inclined towards the Back of the Chimney; becauſe the Smoke takes its Direction according as it is reflected from the flat Part of the Wood.

BOOK

BOOK II. PART II.

CHAP. I.

As ſuch a Diſpoſition of the Chimney as we have deſcribed in the firſt Part of this Book, is not ſometimes ſufficient to hinder the Smoke in cloſe Places; we ſhall now ſhew of what Service the Contrivance for the Paſſage of Air behind the Back is, for hindering Smoke. And that the External Air, which warms a Room by going thro' the Cavities behind the Back, does alſo hinder it from Smoking.

HAving before obſerved, * that the Fire did continually drive out, thro' the Chimney, part of the Air of the Room, and that the moſt common Cauſe of a Chimney's ſmoking, was, that the Air did not come into the Room ſo faſt as it went out of it; if therefore the External Air is let into the Room thro' the Cavities of the Chimney, deſcribed in the *Second Chapter* of the *Second Part* of *Book* I. there will always ſucceed new

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* See Book II. Part II. Chap. I.

Air to that which goes up the Chimney; if therefore we make the Paſſage for the External Air open enough to let in as great a Quantity of Air as that which goes up the Chimney, the Room will always be kept ſo full, as to hinder the Smoke from coming into the Room, unleſs the Wind blows down the Chimney, (and that we ſhall ſhew how to prevent) and ſo the internal Cauſe of a Room's ſmoking, which is the only Cauſe of Smoke in Places not commanded, will be quite taken off.

It may be ſaid, that if only a freſh Supply of Air be wanting, then opening a Door or a Window will do the Buſineſs; this indeed will give Air, but often too much, always cool the Room, and yet often not hinder it from ſmoking; for if the Door or Window which is opened looks towards a Point oppoſite to that from whence the Wind blows, then (as we have ſhew'd before) will the Wind blow down the Chimney, and fill the Room with Smoke, even ſo as to drive it out at the abovemention'd Door or Window. But the Air that comes in thro' the Cavities behind the Chimney (when there is a Fire) will come into the Room, let the Wind blow from any Point of the Compaſs, and warm the Room at the ſame time. It is true, that it comes in faſter, and therefore in a greater Quantity, when the Wind blows upon the Hole, to admit the External Air, and ſlower in calm Weather: But if the Cavities are rightly proportion'd, you will not fail of the End propoſed; becauſe when the Wind blows, there ought to come in more Air to overcome the Reſiſtance that the Smoke meets with at the Top of the Funnel; and in ſtill Weather, the Air will come in a ſufficient Quantity to overcome the then leſs Reſiſtance. There is alſo required a leſs Supply of freſh Air, when the Funnel of the Chimney is narrow, and you make a leſs Fire.

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CHAP. II.

Of the Bigneſs of the opening of the Sides and Cavities of the Chimneys, in order to let in as much Air as is neceſſary to hinder the Smoke.

WHen you would only warm the Room, ſuch Care need not be taken in the Proportion of your Cavities, thro' which it comes into the Room; becauſe all the Inconveniency will only be, that the Room will not be ſo ſoon warm'd: But it is not ſo, when you would prevent Smoke; making the Hollows too big, would, indeed, do no other Hurt but hinder the Room from being ſo ſoon warm'd; but then making them too ſmall, would make them uſeleſs, becauſe there muſt come in as much Air as goes out, to act upon the Smoke, which otherwiſe would certainly come into the Room. But we muſt not imagine, that the Hole where the Air comes in, ought to be as big as the Bore of the Funnel of the Chimney; for tho' a greater Quantity of Air can paſs thro' the Funnel, than thro' the Hole of Communication B. [*Fig.* 4 & 6] yet as much may come into the Room at B, as the Quantity which goes out at the Funnel; becauſe it may (and indeed does) go faſter thro' the one than the other; and if it goes in fiteen times faſter, for Example, then it is enough for the Hole R to be put equal to the fiſteenth Part of the Hole of the Funnel; nay, and it muſt be leſs, for there does not go out thro' the Funnel as much Air as it can contain, becauſe the Smoke goes out along with it. Beſides, the faſter the Air goes up the Chimney, the more is the Room emptied, and conſequently the external Air meeting with leſs Reſiſtance comes in the faſter.

If you would have an Example to prove what I affirm, let it be conſider'd, 1*ſt*. That as much Water ſhall paſs thro' the Arches of a Bridge, as in the whole Channel of the River, tho' thoſe Paſſages may not be equal to above a third Part of the ſaid Channel.

2*dly*, That more Water goes out of a Veſſel the firſt Quarter of an Hour, than the Second.

3*dly*, Tho' you ſhould encreaſe the Hole of the Veſſel during the ſecond Quarter of an Hour, yet there might go out leſs Water than during the firſt; becauſe the Water being more preſs'd, goes out with more Velocity in the firſt, than in the laſt; ſo it is of the Air.

The juſt Proportion of the Hollows, according to the Bigneſs of the Chambers, will be given in the Third Book.

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CHAP. III.

That the coming in of the External Air to drive out the Smoke, does not hinder the Rays of Heat from coming into the Room.

IF the Rays of Heat were of the ſame Nature as Smoke, then indeed the Air would hinder them from coming into the Room; but whereas the Smoke is hardly any thing elſe but the Moiſture of the Wood, reduc'd into a Vapour by the Heat; the Rays of Fire are made up of the ſolid Parts of the Fuel darted with a great Force from the Fire, which eaſily paſs thro' the Air; and the more ſo, the more it is rarified: Nay, we know that they will paſs thro' Silver, Iron, or Braſs. Thus Sounds are hindered by contrary Winds, whilſt the Particles of Light are darted to us with the ſame Force, which way ſoever the Wind blows.

N.B. Monſieur GANGER's Fourth Chapter, recites ſeveral ways that have been uſed, without Succeſs, by ſeveral Architects, for preventing Smoke; and therefore we thought it needleſs to Tranſlate.

BOOK II. PART III.

CHAP. I.

In ſome Caſes, Chimneys are commanded in ſuch a manner, that beſides what we have already mention'd, there muſt be a particular Diſpoſition of the Top of the Funnel on the outſide, which we ſhall give in this Part; but we muſt no way neglect the Helps given before; but when Neceſſity requires, we muſt make uſe of them altogether. Concerning the truncated Pyramids, which may be added outwardly to the Hole at Top of the Funnel of Chimneys, to help the Smoke to go out, and hinder the Wind from coming in.

SInce a Chimney ſmokes where it is commanded, we ought, as often as we can, to build them up higher than the Top of all the Houſe.

[*Fig.*8.] And becauſe A*a*, the Length of the Hole at Top of the Funnel, often gives way for the Wind to blow down the Chimneys, and drive down the Smoke, we muſt divide the ſaid Hole into ſeveral little Squares, whoſe Contents taken together, are to be equal to the Hole as it was without them: Then a Wind that blows in the Direction A*a*, will be as much hinder'd from going into the Funnel, as if it had come in a Direction perpendicular to it. But becauſe making the Hole into Squares, will not enough break the Wind; (for when the Air is in Agitation, it may reſt upon the Flats of this divided Hole, and the Compreſſion occaſion'd by that Means may force Air down the Chimney;) therefore we muſt add ſquare hollow truncated Pyramids, whoſe Baſes are bigger, and upper Holes leſs, than the ſquare Openings of the Funnel: The Pyramids thus parted at Top, tho' joining at Bottom, will hinder the Wind from blowing into the Chimney, whatever Point it comes from.

1*ſt*, Becauſe by cutting and dividing the Wind, they will diminiſh its Force.

2*dly*, Becauſe as they are terminated with an Edge, there will be no Horizontal Plane upon which the Air can be compreſs'd ſo as to encreaſe its Spring; as it happens at Top of thoſe Funnels that have any Flat to reſiſt.

3*dly*, Becauſe from whatſoever Point the Wind blows, it can find no eaſiy Entrance, the Top of each Pyramid being very narrow.

4*thly*, Becauſe tho' ſome Wind ſhould come in, each Pyramid being narrower at Top than at Bottom, that Wind will grow weaker as it deſcends, and the Hole of the Square of the Funnel being leſs than the Baſe of the hollow Pyramid that covers it, the greateſt Part of ſuch Wind will meet with Reſiſtance and be reflected upwards.

5*thly*, Becauſe the Wind does not equally go into all the Pyramids, and if it ſhould come in at one or two of them, it would eaſily come out at the others.

The way that I firſt diſcovered that the Length of the Hole at Top of the Funnel did ſometimes cauſe Chimnies to ſmoke, was this; I obſerved that of two Chimnies in one Apartment which ſmoked, they never ſmoked both at the ſame Time; and found it owing to the Poſition of the Length of the Holes of the Funnels, the one being perpendicular to the other: For that Chimney did not ſmoke againſt which the Wind blowed perpendicular to the Length of its Hole; ſo by dividing its Hole into Squares, the Wind could only blow in the ſame manner, as if its Direction was perpendicular to the Length of the Hole, as before. And to prevent the Inconveniency that might happen when its Direction is inclined downwards, I added the truncated Pyramid above mentioned, and ſince I have never been troubled with Smoke. The Houſe indeed is very high, and the Chimney not commanded; but for ſuch Chimnies as are lower than ſeveral Buildings about them, if theſe Pyramids are not ſufficient, then apply the Capital which we are going to deſcribe.

CHAP. II.

Concerning the Capital * *to be added to the abovementioned Pyramids, to hinder the Wind from blowing into ſuch Chimnies as are commanded, or too much expoſed.*

THE Pyramids mentioned in the foregoing Chapter, are but part of the Contrivance to hinder Smoke; but we have given their Deſcription by itſelf, becauſe upon Tryal they have ſucceeded very well; but as ſome times there may be Caſes wherein they don't ſufficiently hinder the Wind, one may add above them the triangular Priſm S R Q *q r s*, [*Fig.* 9.] either hollow or ſolid, as long as the Hole

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* *The* Second Chapter *of the* Second Part *of the* Third Book, *will make plain what ever may ſeem difficult here.*

of the Chimney bearing with one of its Angles R *r* upon the middle of the three Holes of the Pyramids, by that means dividing thoſe Holes in half, its Plane S Q *ſq* oppoſite to that Angle, will be parallel to the Squares of the Holes that are Horizontal, and as broad as any of the Holes, that nothing may fall into them that comes down perpendicularly upon that Surface S Q *q s*; and above that Priſm may alſo be added, a Capital open at Top, equal in Length to the Priſm, and divided into ſeveral other little ſquare truncated Pyramids, whoſe Planes I H G *g h i*, N O P *p o n* below the little Pyramids, muſt be open enough at Bottom to leave a Space on each Side of the Horizontal Plane of the Priſm, and long enough to go down below its Angle R *r*, that bears upon the firſt Pyramid, to cover part of them without touching them. I ſay, that ſuch a Capital will wholly hinder the Wind from going into the Chimney, whatever Situation it has, and from whatever Point it blows; and the Smoke will come out freely. [*Fig.* 8, 9, 11.]

For, 1*ſt*, The Smoke will meet with no Stop but inclined Planes, along which it will ſlide eaſily, and ſo go out freely.

2*dly*, The Wind which coming Sidewiſe blows Horizontally, will not go into the upper Pyramids, for the Reaſon given in the foregoing Chapter; neither will it blow into the under ones upon the ſame Account; and when its Direction is perpendicular to L *l*, the Length of the Capital, it may even help the Smoke to go out upwards, by blowing in at the lower Holes; for the lower Pyramid making a Reſiſtance, the Wind will be made to go upwards, where it will carry the Smoke before it.

3*dly*, The North Winds, and all Winds that blow downwards, and ſo may enter into the little Pyramids of the Capital, will always find an eaſier Paſſage thro' the Sides *Gg*, P*p* open downwards, (and will that way carry the Smoke with them,) than there would be to go into the under Pyramid, whoſe Holes are covered by the Horizontal Plane of the triangular Priſm. The ſame thing will happen in reſpect of the Winds which encreaſe the Spring of the Air, by the Reſiſtance they meet in ſtriking againſt the Eminences which command the Chimnies; thus no Wind will be able to go into a Chimney that has this Contrivance, neither will the Smoke be hindered from coming out of it.

N.B. Monſieur GAUGER's third Chapter recounts ſeveral unſucceſsful Contrivances applied to the Tops of the Funnels of Chimnies to prevent their ſmoking, for which Reaſon we omit it.

CHAP. IV.

Shews how inconvenient the Smoke is, and how neceſſary it is to prevent it.

ALL Rooms are not equally apt to ſmoke, and thoſe that ſmoke moſt, ſmoke not equally at all Times: Sometimes the Smoke is ſo violently driven into the Room, that the Fire muſt be put out, it being leſs troubleſome to bear the Cold, than the Smoke. This does not indeed happen in all Appartments; but there are none but what ſmoke when they are very cloſe; and if you don't bring in warm Air in Winter, you muſt either ſuffer the Cold, or the Smoke. Smoke makes the Eyes ſmart, ſpoils the Goods in a Room, blackens our Cloaths, and the Ladies Linnen and Lace. Beſides theſe, there are ſeveral other Effects of Smoke which are very pernicious: Several People have been killed with Smoke, and the Vapour of Coals, from which that of Wood differs but little. I once had ſuch Experience of it, as had liked to have proved fatal: I had cauſed a Stove to be made in my Cloſet in the Country, and having uſed it but a few Days, did not ſo readily find the Inconveniences of it; but one Morning the Wind blew into the Flue ſo forcibly, as to fill my Cloſet with Smoke in a Moment, and drove out the Flame thro' the little Vent-Hole; I immediately took out the Wood, and put Charcoal in the Room, and ſo having leſs Smoke, I ſtaid two or three Hours longer writing in my Cloſet*: as ſoon as I went out I was taken with ſuch a Giddineſs in my Head, Qualms and Fainting, that I eaſily gueſſed that if I had ſtaid a longer time in the Cloſet, the Conſequence of it would have been fatal. Therefore, tho' we may not at firſt feel the Inconveniency, yet at long run we ſhall find the pernicious Effects of drawing Smoke into our Lungs or Stomach, or Air impregnated with Smoke.

The Reader may have hitherto obſerved, that all the means uſed to prevent Smoke, were the ſame uſed for the encreaſing of Heat. The Parabolical Jams or Sides; the Cavities behind the Back of the Chimney, for introducting and warming the External Air which ruſhes

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* *It will not be improper to give an Account of ſome Experiments to this purpoſe. If you draw the Air out of the Glaſs-Receiver of an Air-Pump, and let in Air to fill up that Vacuity in ſuch manner, that it ſhall paſs thro' the Smoke or Flame of Sea-Coal, or Char-Coal, and drive it before it as it ruſhes into the exhauſted Receiver; that Air will be ſo vitiated, as to kill a Cat in a very little time, if, taking off the Cover of the Receiver, you put the Cat into the Receiver filled with this Air, thus impregnated with the Steams ſeperated from the Sea-Coal or Char-Coal; thoſe of Char-Coal being always found moſt pernicious,*

ruſhes into the Room; and the Contrivances *In*, and at the *Top* of, the Funnel to keep back the Wind, all tend to *prevent the Smoke*, as well as to *encreaſe the Heat*; and thoſe that prevent *one*, are propereſt to prevent *another* ill Effect of the common Chimnies.

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BOOK.

BOOK III. PART I.

The Two foregoing Books have only ſhewn the Uſe of our New Chimnies, by giving a ſlight Deſcription of them; but we ſhall here be very particular, in order to inſtruct the Workman how to make them eaſily; and ſhew the Conſtruction of the Hearth and Jams of the Chimnies, and of the Hollows that muſt be left behind, as well to increaſe the Heat, as to hinder the Smoke..

CAHP. I.

Of the Model, by means of which the Workman may give Chimnies that Sweep or Curvature which they ought to have.

WE here ſuppoſe the Chimney 4 Feet wide, and 20 Inches deep; tho' we ſhall alſo give the Proportion for Models, when the Chimnies are larger or leſs.

[*Fig.* 12.] Take a Board AB *ba* 4 Feet long and 20 Inches broad, whoſe Sides are all ſquare to one another; from the Middle M of the Side B*b* mark MC eleven Inches, and from C, the Length CG of 4 Inches, draw the Line GA, on which take GH = 5 Inches, from H draw HP ſquare or perpendicular to GHA, join HC, and upon I, the Middle of that Line, draw IP perpendicular; then from the Point P, where it cuts the Line HP, as your Center, with the Diſtance PH, or PC, draw the Arc HC; then do the like on the other Side, where you have the ſame Letters in a ſmall Italick Character.

Within an Inch of the Side B C *c b* of the Board, mark the Rectangle K*kt*T a Foot long, and 8 Inches broad, its Middle being over-againſt M; and within 3 Inches of KT, draw another ſmall Rectangle Z 3 Inches long and two and a half broad, whoſe Middle muſt be over-againſt the Middle of K T; cut out the Stuff where thoſe Rectangles are drawn, and having alſo cut the Board away along the Line A H C M *c h a*, you will have the Model for the Back and Sides of the Chimney.

We have ſuppoſed the Breadth A*a* of the Chimney to be 4 Feet; but if it was but three and a half, then CG ſhould be taken but equal to 3 Inches and a half, and but 3 Inches if A*a* be only 3 Feet wide, GH 4 Inches and a half in the firſt Caſe, and only 4 in the laſt.

In all theſe Caſes you may make *g h* equal to *g c*, and draw perpendicularly from thoſe two Lines, *c p* and *h p*, and about *p* the Point of their Interſection, with the Diſtance *p c* or *p h*, draw the Arc *c h*, and do the ſame thing on the other Side.

If you would have the Sides A H C, *a h c*, which are nearly parabolical, to be ſtrictly ſo, then each Side muſt be a half *Parabola*, having F *f* for their Focus's; [*Fig.* 2.] the Back between the Vertex of each being left ſtreight; and any Work-man that can but draw a *Parabola*, may fit the Model, tho' there is no need of being ſo exact; becauſe, ſince the whole Deſign of the Parabolical Jams, being to throw all the Rays of Heat into the Room, the ſame Effect will be produced by Sides that are nearly ſo.

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CHAP.

CHAP. II.

Firſt Conſtruction *for the ſimple Chimnies,* [*Fig.* 6.]

1*ſt*, THE Model AHC *cba* for the Sweep on the inſide of the Chimney, being drawn after the manner ſhewn in the foregoing Chapter, muſt be laid on the Hearth, or the Place deſigned for the Hearth of the Chimney, in ſuch Manner, that the Points A *a* touch the forepart of the Jams or Sides, which muſt be raiſed up along AHC *cba*.

2*dly*, The lower part of the Breaſt or Place under the Chimney-Piece, muſt be an Horizontal Plane, reaching within 10 or 12 Inches of the Back; for the Funnel muſt be left no bigger, as may be ſeen in *Fig.* 3.

[*Fig.* 4.] 3*dly*, If the Funnel does not go ſtreight up, the Wings of it B*e*H, *b*G*b* muſt be made Parts of a Circle from B and *b*, the Top of the Jams, up as high as the Cieling H*h*, continuing a Line on the Horizontal Plane at Bottom of the Breaſt, and from a Point taken upon it behind the Back, may be drawn the Arc B*e*H.

Theſe three Poſitions of the Jams, the Horizontal Plane, and of the Funnel which muſt alſo be uſed in all the other Chimnies of which we ſhall make mention, are for the firſt Conſtruction, which, tho' it ſeems very little to differ from common Chimnies, gives abundantly more Heat without a bigger, nay with a leſs Fire; as we have ſhewn in the ſecond and third Chapters of the firſt Part of the firſt Book.

[*Fig.* 6.] You may, if you will add the Aſh-Hole K*kt* T, and the Bellows *Z*, the Conſtruction of which we ſhall give in the 10th Chapter.

This firſt Conſtruction may be effected with very little Expence in all ſorts of Chimnies, and very little Trouble or Alteration; but then it encreaſes the Heat only by reflecting more than common Chimnies; and it would not always be ſufficient to prevent Smoke in Rooms that are apt to ſmoke, tho' it will cure ſeveral ſmoking Chimnies, as we have ſhewn in the 1*ſt*. *Chap*. *Part* III. *Book* II.

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CHAP.

CHAP. III.

Second Conſtruction, *being that of Chimnies which ſupply us continually with new Air, which is warmed in paſſing thro' Cavities behind the Back of the Chimney.*

THE foregoing Conſtruction differs ſo little from the common way of building Chimnies, that the Workman will find no Difficulty in effecting it; but the ſame cannot be ſaid of the Conſtruction which we ſhall give in this, and in the following, Chapters.

To make it the eaſier, we ſhall firſt deſcribe each Piece by it ſelf, and then ſhew how they muſt be joyned and laid.

[*Fig.* 13.] The firſt Piece*, which is very ſimple, muſt be a Plate of Iron or Braſs HI *i h* about 4 Feet in Length, and 3 Feet and a half high, made up of ſeveral Sheets joyned together.

Now as the Flame continually beats againſt the Middle of this Plate towards the Bottom, and the Coals always lie againſt it, you may, in that Place, add a ſmall Plate ODFIL of the Shape repreſented in the Figure, having round about it a little Frame of Iron half an Inch thick, the whole being ſcrewed with Screws that have their Nuts fixed behind, that you may at any time take off the Plate, and fix another, without altering the Chimney.

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* *This firſt Piece is marked* 2d *Piece in this Figure.*

The other Pieces are to be little Strips of Plate Iron 5 Inches wide, and about 10 Inches ſhorter than the Height of the great Plate to which they muſt be fixed behind, along the Lines H I, C X, *cx*, *hi*, in ſuch manner, that the firſt ſhall begin from the Top, and end 10 Inches above H; the ſecond muſt begin at Bottom and come 10 Inches ſhort of the Top; the third muſt be as the firſt; and the fourth as the ſecond, as you may ſee in *Fig.* 21.

[*Fig.* 13.] Sometimes it will be well to have four of the narrow long Plates between H and *h*; but now we ſuppoſe only two, in order to make the thing the more intelligible, and that it may be the more eaſily performed by the Workman; for when a Man underſtands it, and can do it in this ſimple manner, he may eaſily go on to a more complexed Conſtruction.

Theſe long Plates being thus fixed, ſet the Middle M of the Plate over againſt the Middle M of the Model A H C M *cha*, then bend it round according to the Model in ſuch manner, that lifting the Model up and down in an Horizontal Poſition, it may fit the Plate (as it ſtands upright) from the theTop to the Bottom; and you will have the ſecond Conſtruction, which you muſt lay or fix in the following Manner.

The Way of laying or fixing the Second Conſtruction *for a Chimney.*

Before we lay this Chimney, or the others, whoſe Conſtructions we ſhall give in the following Chapters, there muſt be made a ſquare Hole, of about a Foot, in the neareſt Wall that looks towards the Street, or into a Court-Yard, or any where out of Doors, about the Level of the lower Part of the Floor, or even below that; to this Hole, if Neceſſity requires, join a Paſſage, or Canal, thro' which 60 or 70 ſquare Inches of Air may paſs; this Canal may be carried in the Wall, or between the Joyſts under the Floor, or bearing againſt the Wall in the Room, as ſhall be thought moſt convenient to bring the External Air into one of the Cavities behind the Chimney.

If it be thought needful, or moſt convenient, Air may be brought in at Top of the Funnel of the Chimney, making within it a ſmall Canal, which muſt be carried down a little way below the Hearth, and ſo made to turn up into the firſt Cavity; but then ſuch a Channel muſt be made when the Chimney is firſt built, otherwiſe it would be very difficult. The Paſſage for External Air being made, ſet upon the Hearth of the Chimney, or on the Place where it is to be, the Model A H C M *c h a* [*Fig.* 19.] between the Jams, or the Places where they are to be; the Fore-part A*a* muſt be in the ſame Line as the Chimney-Piece or Fore-part of the Jams; along the Model muſt be drawn the Sroke A H C *c h a*, on which muſt ſtand the great Plate on the inſide of the Chimney: Four Inches beyond the firſt Stroke, or firſt Line, draw another (where the Cavities are to be) parallel to the firſt, to be taken in part out of the Wall of the Back if poſſible, out of which you muſt dig it to the Height of three Feet and a half; but if the Wall will not allow it, bring forward the Model, ſo as to leave behind it four Inches over-againſt the Line C*c*; in that Caſe alſo the Jam muſt be made forwarder in the Room, and, if there be Occaſion, the Fore-part of the Funnel may alſo come forwarder into the Room; you muſt fill up the Spaces A H M, *a h m*, and thoſe that are beyond the ſecond Curve Line M N, *m n*, but without ſtopping up the Paſſage D *y*, thro' which the Air muſt go into the Cavities behind the Chimney; then in the Bottom and Sides muſt be made little Trenches as M, N, *n*, *m*, to ſink into them, the long Plates which are behind the great Piece; and from the Place where the outward Air comes in behind the Chimney, make a little Channel H Z, which ends in a Civity that muſt be made under the Vent-Hole or Bellows Z, about 12 or 15 Inches from the Back forwards; the Conſtruction of this Vent-Hole is given in the 10*th Chapter*. This Cavity thus ordered, the Chimney muſt be laid; that is, the great Plate ſet upwright in ſuch manner as to fit to the Model all the way on the inſide, and the long Plates on the Backſide muſt fit into the Trenches made for that purpoſe, and there muſt be four Inches between the great Plate and the Wall: Then all the Places muſt be cloſe ſtopped where the Air can go in or out, except the Cavities themſelves, and the lower Hole D, and the Hole R or *r*, which muſt be left above.

If you find it difficult to fill thoſe Trenches, after the long Plates are got into them, then before you place the whole Piece, fill the Trenches with ſoft Plaiſter, or Morter, that the long Plates may, as they are thruſt in, be fixed, and that way they will be cloſed.

The whole Difficulty may be avoided, and ſeveral other Conveniences be had, if you ſhut up thoſe Plates by a great Plate parallel to the firſt; for then it will make a ſort of a divided Box, which it would be eaſy to lay and ſeal; and, if Occaſion be, to take it off and carry it to another Place: The manner of doing it eaſily, may be ſeen in the ſixth Chapter.

If the Cavity behind the Back of the Chimney is not taken in the Wall, it will be proper to nail a great Piece of Plate-Iron at the Top of the great Plate, to ſhut up the back Space, or to hold the Morter that is laid on to ſhut it up.

[*Fig.* 6.] The Chimney being thus laid and ſeal'd, or cloſed, from whenceſoever you take your External Air, you muſt bring it quite to D, where it will go up into the firſt Cavity, go down the ſecond, then goes up again thro' the third, out of which it will go into the Chamber thro' the Hole *r*, where there are only 3 Cells. We ſhewed in the 3*d*. *Chap*. of *Book* I. *Part*. II. the Reaſon of this Courſe of the Air.

But becauſe the Air ſometimes will not acquire a ſufficient Degree of Heat by going only thro' 3 Cavities; you may, as we have already ſhewn, make 5, by adding 2 more long Plates, and placing them as you ſee in *Fig*. 21. and the Air will go thro' the Cavities, riſing in the firſt, third and fifth, and deſcending in the ſecond and fourth. There might be 7 Cells, if the Plate behind the firſt and great Plate, or the Cavities, be continued quite to the

Fore-part of the Chimney; for 10 Inches Diſtance between each long Plate is ſufficient for common Chimnies; but the Cavity muſt be no leſs, that there may paſs about 40 ſquare Feet of Air; when there is not Room for this Proportion, make the ſecond Cell a little bigger than the firſt, and the third bigger than the ſecond, and ſo on.

The Lines which are drawn winding in the 21*ſt.* and other Figures, ſhew the coming in, the Courſe, and the going out of the Air.

That the Air which is to paſs thro' theſe Cavities may go into the Room but when you would have it, and but in ſuch Quantity as you would have it, there muſt be ſliding Boards, or Doors at the Holes R or *r*, where it comes into the Room, which may be more or leſs open as you ſee fit. You may alſo let in the Air at thoſe Holes ſo as to have it hot or cold, or temperate in any degree; as we ſhall ſhew in the 9*th. Chapter*.

If you would burn Wood, the Billets ſtanding upright, as I am told the *Swedes* do, you may make the Chimney an exact *Parabola*, which will be of uſe where you muſt have very narrow Chimnies, as in Corners.

CHAP.

CHAP. IV.

Third Conſtruction, *by which the freſh Air which comes conſtantly into the Room, is heated both behind the Back of the Chimney, and under the Hearth.*

IN the foregoing Conſtruction, the Air is only warm behind the Back and Sides of the Chimney; but it may ſtill acquire much Heat in going under the Hearth.

[*Fig.* 13. *Firſt Piece.*] To have the firſt Piece of this third Conſtruction, you muſt lay the Model (which we ſuppoſe rounded and cut thro') upon a Plate of Braſs or Iron, a little longer, and a little broader, than it is; then firſt draw the Curve Line AHCM *cha*A, round about this Model, and then another parallel to it about 3 fourths of an Inch, beyond the firſt Line, as you ſee it pointed in the Figure; you muſt alſo ſcribe, or draw, K*kt*T, the Place for the Aſh-Hole, if you would have one, and a little forwarder one for the Vent-Hole *z*; thoſe two Places muſt be cut thro', but the Aſh-Hole, if poſſible, muſt be ſunk an Inch. In the 10*th. Chapter* we ſhall give the Conſtruction of the Trap-Door, which muſt be fixed to the Hole Z, where the Wind is to come in. Laſtly, you muſt fold downwards to a Square all the Part which is beyond A*a*, and ſo you will have the firſt Piece.

[*Fig.* 13. *Second Piece.*] The ſecond Piece is a Plate of planiſh'd Braſs, or Copper, ABEG*geba*, as long as the Round of the Back and Sides of the Chimney, that is, in this Caſe of about 6 Feet, (it might be of Plate-Iron, and only 4 Feet in length, and 3 Feet and a half high; fold the lower Part and the two Sides to a Square a little more than the Breadth of a quarter of an Inch: Set off upon each Side the Heighth AB *ab*, of 2 Feet and 8 Inches each; when the Plate is 6 Feet long, and covers the whole Compaſs of the Chimney, take off the two little Rectangles BEG, *beg*; in the Middle of this great Plate, put a little Plate, with its Frame, as we ſaid in the foregoing Chapter.

You muſt alſo cut out little Plates 5 Inches broad, ſome 2 Feet and a half, and ſome about a Foot long, as may be ſeen in *Fig.* 22, to make Partitions under the ſecond Piece, and below the firſt; and then you will have all the Pieces fit to finiſh the Chimney.

To joyn them together, turn the ſecond Piece GEBAM *abeg* upon the Model AHCM*cha*, which you muſt hold to it in ſuch Manner, as to have its Middle M anſwer to the Middle M of the ſecond

Piece, and then ſet the Model upon the Stroke A H C M *c h a* of the firſt Piece; ſet up the ſecond upon the firſt about the Model, in ſuch manner, that its Concave Side may every where touch the Convex Part of the Model.

As what is folded along the Line ACM *c a*, is but little above a quarter of an Inch, and that which exceeds this Stroke of the Model in the firſt, is about three quarters of an Inch, there will be almoſt half an Inch of Stuff exceeding the other Pieces, which you muſt fold back again, or turn up over the lower end of the ſecond Piece, putting here and there Rivets, and ſo you will have theſe 2 Pieces ſo faſt to one another, as to leave no Paſſage for Air or Smoke, which ought to be taken great care of: When theſe Pieces are made of ſeveral Iron Plates, the Rivets muſt be very near together; but if they are Braſs or Copper Plates, they ſhould be ſoldered with hard Solder, or at leaſt thoſe that make up the ſecond Piece.

[*Fig.* 13.] Laſtly, You muſt fix upon the Square behind the ſecond Piece on each Side of the Middle M, 2 Partition-Plates 5 Inches wide, at leaſt 5 Inches diſtant from M, and the 2 next, 15 Inches diſtant from it, that there may be 10 Inches between each; fix ſuch Plates under the firſt Piece that makes the Hearth, which muſt joyn to the others in the Shape of a Square, that is in a right Angle. The firſt and the third of them muſt go ſo far, as the Line A*a*, which is the Fore-part of the Hearth; and the ſecond and the fourth muſt come as far ſhort of the Top of the ſecond Piece, *viz.* about 10 Inches. If you would have the Courſe of the Air be longer, it is but adding two more Partition-plates, to have 5 Cells, as in *Fig.* 22; you may have 7 if you will.

The Partition-plates under the Hearth, may be laid parallel to the Back of the Chimney, and lye from one Jam towards the other, as in the *4th* and 23*d* Figures. Thoſe likewiſe behind the Back, may have an horizontal Poſition, as in *Fig.* 23; which may be more eaſily done, if the Back be ſtreight, and the Jams parallel, as in common Chimnies; it is more difficult, if the Back and Sides are rounded after our Method given; but that is not the Reaſon why we don't uſe them ſo, (for they might be fix'd along that part of the Back which is ſtreight,) but the perpendicular Situation goes part of its Journey deſcending, as may be ſeen in *Fig.* 22, *&c.* and ſo is longer in paſſing thro' the ſame Number of Cavities.

Tho' thoſe ſeveral Poſitions of the Partition-plates be eaſy to be underſtood by a Sight of the Figures; yet it will be beſt for the Workmen to uſe themſelves firſt to one Poſition of them, 'till they can make them eaſily, or at leaſt to have Models, tho' but of Paſtboard.

How to lay the Third Conſtruction *for a Chimney.*

When you have made the Way for the External Air, after the Manner mentioned in the foregoing Chapter, and have digg'd out the Space in the Back-Wall, you muſt alſo dig in the Hearth to the Depth of 4 Inches, and beſides that, make Trenches to fit the Partition-plates into; then from the Plane where the External Air comes in under the Hearth, make a ſmall Channel HZ, which muſt end in the Cavity that belongs to the Vent-Hole Z. The Hollows being thus prepared, lay or fix all the Plates now join'd, in the Manner before ſhewn.

The Chimney being laid, and made cloſe, and the external Air being brought to the Hole D, it will go winding thro' the Cavities in the Direction repreſented by the winding Lines, *Fig*. 22 and 23.

What we have ſaid concerning the Hole R or *r*, for the laſt Conſtruction, muſt alſo be underſtood of this.

CHAP. V.

Fourth Conſtruction, *whereby the freſh Air coming continually into the Room, acquires Heat behind the Back under the Hearth, and alſo under the Mantle-Tree, or Fore-part of the Breaſt.*

BESIDES the Cavities mentioned before, the Air may got hro' another made over the horizontal Plane at the Bottom of the Breaſt.

[*Fig.* 13. 1*ſt.* and 2*d. Piece*] The two firſt Pieces for this fourth Conſtruction will be drawn, cut, and put together as thoſe of the foregoing, mention'd in the laſt Chapter; but you muſt have only 4 Partition-plates behind the ſecond Piece, in the Manner ſhewn by the pricked Lines, HI, CX, *cx*, *hi*.

[3*d. Piece.*] To have the third Piece, lay the Model AHC*cha* upon a Braſs or Iron Plate BG*gb*, which is to be about half an Inch forwarder than the Edge A*a*; draw along AH a Line BE equal to BE of the ſecond Piece, and at the other End along *ah* another *be* equal to the firſt; from the Points E and *e*, you muſt raiſe two Perpendiculars EG, *eg* upon the Line E*e*, equal to the Lines EG, *eg* of the ſecond Piece; draw a Line from G to *g*, and another from B to *b*, and cut the Piece within half an Inch of the

Stroke GEB *beg*, and fold it up ſquare along the Line E*e*; you muſt alſo fold upwards, what is left beyond the Line B*b*, and downwards what is beyond the Line GEB *geb*.

The two firſt Pieces being join'd, fix upon the Voids BEG, *beg* of the ſecond Piece, this Third, whoſe Edges BEG, *beg* being folded, will ſerve to nail along BEG, *beg*.

You might with another Piece folded alſo ſquare, (tho' it were but of Tin, or very thin Plate-Iron) ſhut up the Upper and Fore-part of this third Piece, and fix them together with Rivets, to make a ſmall Canal of it; and then fine Mortar might be laid over the Upper and Fore-part of it, which would make it more ſolid, and cauſe the Air to be more heated in paſſing thro' it.

How to lay the Fourth Conſtruction *of a Chimney.* [*Fig.* 24.]

You muſt dig the Cavity in the Back of the Chimney, and in the Hearth, after the Manner that we have ſhewn in the foregoing Chapter, for the Conſtruction there mentioned; then take away whatever is ſolid, under the Mantle-Tree, or behind it, if it be low, to make way for the Canal that muſt be put there; then the Chimney muſt be laid, as we have ſhewn In the foregoing Chapter; you may alſo fix this ſquare Canal to the Stone or Timber at the Bottom of the Breaſt; bring in the external Air as far as the Hole D, from whence it will go into all the Cavities, and go in the Direction repreſented by the winding Line; that is, it will firſt go up the Cavity HCXI, from whence it will go thro' GQE into the Paſſage behind the Mantle-Tree (which Paſſage is taken away in the Figure, the better to repreſent the Way of the Air) and ſo go from SEBL, to *ſebl*; from which it will go out thro' *geg*, then deſcend thro' *ihc*, and go under the Hearth; afterwards riſe thro' C*c* into the middle Cavity *c*CX*x*, whence it will go out thro' one of the Holes R or *r*, or if you will, thro' both at once; little Doors are to be fixed to the Holes, to proportion the Quantity of the Air which comes into the Room. We ſhall give a Deſcription of them in the Ninth Chapter.

[*Fig.* 13.] Thoſe that would ſtill encreaſe the Effect of this Chimney, may eaſily (eſpecially when it is ſomething large) do it by making the Way of the Air longer; one need only put 2 Partition-plates inſtead of one, in the Space CA, *ca*, and leave a Space of 4 Inches round about the Chimney, and you will have 7 Cavities about the Chimney, beſides thoſe under the Chimney-Piece, and under the Hearth ; which laſt may be ſtill divided; but all this would make the Chimney too complex and chargeable; the next Conſtruction is much more ſimple, and gives a ſufficient Heat.

CHAP. VI.

The Fifth Conſtruction, *which is more ſimple than the foregoing, where the Air only paſſes behind the Back of the Chimney, and is heated faſter than in the other Conſtructions.*

IT was requir'd for the foregoing Conſtructions, to have the Pieces of Braſs or Copper, but they might be made of Plate-Iron ; but it would be difficult to make them ſo exact and clever, eſpecially the great Plate A B G *g b a*; ſuch great Plates of Iron are not managed and worked ſo eaſily, when they are made of many Pieces ; for one cannot get ſuch large Plates of Iron as one can of Braſs or Copper ; and there would be ſo much Work, that the Coſt would be as much as if Copper Plates were us'd.

But it is otherwiſe in this Fifth Conſtruction ; for it may be made wholly of

Plate-Iron, and be as exact as if it was of Copper, be much more ſolid, and laſt longer; for you may find Plate-Iron much thiner than Plates of Copper, and it will much better bear the Fire.

In this Conſtruction it is not neceſſary to have Cavities under the Hearth, nor in the Sides of the Chimney, and conſequenty not to face them (unleſs you have a mind) with Plate-Iron or Copper; beſides, you need not have any Canal under the Mantle-Tree.

To give the external Air ſufficient Heat for warming the Room, you are not only to have in the Back of the Chimney a Box or Caſe, divided within by long Partition-plates, which make up 3 or 5 Cells, having a Communication one with another, which make a Sort of a recurv'd Canal with ſeveral Turnings.

Here follows the Deſcription of every Piece, and the Manner of putting them together, for the Benefit of the Workmen.

[*Fig.* 28. 1*ſt. Piece.*] The firſt Piece muſt be a Piece of ſtrong Plate-Iron 3 Feet, or 3 Feet and a Half high, and at leaſt 2 Feet wide, made of two Plates join'd, (for you can hardly get one Plate of that Bigneſs) and divided in 2 Places, as you may ſee in the firſt Piece of *Fig.* 28, where the prick'd Lines ſhew where the Pieces muſt be join'd, as they alſo do in the other Figures.

The *2d.* *3d.* *4th.* and *5th.* Pieces CG*g*, E*fe*, LH*h*, M*mx*, are 4 little Plates 2 Feet and 3 Inches long apiece, (ſuppoſing the firſt Piece only 3 Feet long) and 5 Inches wide, beſides what is left over and above to turn up for joining them together, as is ſhewn by the prick'd Lines; when thoſe little Breadths are turned up ſquare, let them be fix'd to the fifth Piece along the Lines CG, *f*E, LH, M*x*, in ſuch Manner, that the Letters in the one, may correſpond with the ſame Letters of the other; theſe need not be of ſtrong Plates, any more than the following Piece.

Laſtly, The ſixth Piece muſt be a Plate G*g*X*xmc*, 3 Feet 9 Inches long, and 2 Feet wide; its End C*c*, X*x* muſt be fix'd to the 2 Ends C*c*, X*x* of the firſt Piece, and to the other Pieces where it is to touch them; but at firſt you muſt only fix the ſecond and third to the firſt, then the ſixth; then the fourth and fifth, becauſe that way you won't be hinder'd from rivetting the others: All theſe Pieces thus united, will make up the Box C*g* X*xmc*, *Fig.* 27. which is required for this ſixth Conſtruction.

The Partition-plates and Cells are here Vertical, but they might be Horizontal, tho'

tho' they are better in the firſt Situation, for the Reaſon given in the fourth Chapter.

[*Fig.* 21.] The firſt Piece, or Foreplate, might be made 3 Feet and ſome Inches wide; then fixing the Partition-plates in the Manner, and at the Diſtance before given, there will be left on each Side the Breadth CH, *ch* of about 7 or 8 Inches; at the Sides of the Plate fix two little Plates the whole length, about an Inch wide, or elſe turn down the Plate it ſelf, in order to make it keep its Figure, and the better to cloſe it when the whole Box is laid, as we ſhall ſhew; and by that means you will leave 2 more Cells, which will ſtill give more Heat to the Air; becauſe having a longer Journey to go, it will be longer encompaſs'd with Heat.

This Box may, if you will, be of caſt Iron, if you make it of two Pieces, one of which has all the Partitions, and ſo join them together with Screws. The ſecond and third Conſtruction may alſo be of caſt Iron, eſpecially when you have but 3 Cells.

How to lay the Box, *for the* Fifth Conſtruction *of a Chimney.*

[*Fig.* 21. and 29.] Firſt of all, lay the Model AC*ca* upon the Hearth, to draw the curve Line AC*ca* and to mark out the Aſh-Hole KT*tk*, and the Place for the Vent-Hole Z: Then dig in the Wall the depth CN*nc* of about 5 Inches, and of the ſame Height as the divided Box; or if the Wall will not allow it, bring forward the Jams, if the Chimney is not deep enough, that you may have behind C*c* (the Back of the Chimney) a Cavity CN*nc* about 5 Inches deep; dig alſo the Aſh-Hole in the Hearth about 2 Inches deep, and quite as far as the Bottom or Back-part N*n* of the Cavity made for the Box; bring a little Canal HZ under the Hearth into the Cavity Z, which is under the Vent-Hole or Bellows, then put the Box into the Cavity made in the Back of the Chimney, in ſuch manner, that the Bottom of it C*c* may be raiſed about 2 Inches above the Hearth, and a Space of about half an Inch may be left behind the Box quite to the Top of it, (as you may ſee in *Fig*. 26.) and go out about X*x*, where the little Openings VVV (*Fig*. 21.) muſt be left; this Piece, thus laid, muſt be cloſed every way, except at Bottom, where it muſt not come beyond the Line C*c* drawn upon the Hearth; you muſt fill up the Sides of the Chimney along AHC*cha*, that it may have the Shape of the Model; fix the little Trap-Door, whoſe Conſtruction we ſhall give in the 10*th* Chapter, over the Cavity Z, and this Chimney will be finiſhed if you would have but 3 Cells. But if you have made the Fore-part of the Box of the whole Breadth H C *c h*, in order to have 5 Cells, [*Fig.* 28.] dig out of the Wall alſo the Cavities H P N C, *h p n c*; [*Fig.* 29.] Give the Plate the Shape of the Model, from H to *h*, [*Fig.* 21.] and lay the Box as we ſhewed; the laſt Partition-Plate on each Side, together with the Part of the Fore-Plate C H *c h*, which exceeds the Box, with the Surface of the Wall H P N *h p n* will make the two other Cells, behind which the Heat is not to paſs, but only behind the other three.

This Chimney being thus laid and ſealed, the Air that is brought from without, in the Manner ſhewed in the third Chapter, being come as far as *c*M [*Fig.* 21.] will go into all the Cavities of the Box L H E F G, and go out thro' G X, to go into the Room thro' R, when you have only 3 Cells; but if you have 5, the External Air going in at D*y*, will go thro' G, E, H, M, to come into the Room thro' *r*, as the winding-Line plainly ſhews; you may let it come into the Room thro' the other Side R, and even thro' both at once; if you would have cold Air alſo come in at *r*, you muſt bring that Air from the Vent-Hole as far as *h a*, and from thence as far as the

Hole; the pricked Lines in *Fig.* 21. ſhew the way.

You muſt, as much as you can, contrive it ſo, that the External Air does not immediately go into the Box, eſpecially when it has but 3 Cells, but let it wind a little firſt.

Tho' in this Conſtruction the Air has not ſo many Windings, as in thoſe mentioned before; yet it acquires as great a Degree of Heat as in the fourth, and a greater than in the ſecond and third; becauſe the Heat that goes behind the Box, warms it on that Side, and the Flame and Fire before; and as the Partition-Plates are between, they are heated at the ſame time; ſo that the Air which in the other Conſtructions receives its Heat only from the Fore-part of the Cavities, is here heated from all Parts, as paſſing thro' a Canal encompaſs'd with Heat; and if you ſuppoſe that it takes up 8 Moments in going thro' the Cavities in the other Conſtructions, and only 4 in this, it will here acquire 3 or 4 times more Heat every Inſtant: So it will here acquire as great a Degree of Heat in 2 Moments, as it does in 4 or 6 in the other Conſtructions.

If to this Conſtruction you add a Cavity under the Hearth, as in the 3*d* and 4*th*, thro' which you bring the Air, before it goes into the Box, you will increaſe the

Heat; as alſo, if you face the Sides of the Chimney with thin Copper, or even with Tin Plates.

Cold Air may be brought in one of theſe ways, which we ſhall give in the 9*th* Chapter.

The fifth Conſtruction is ſo ſimple, eaſy and cheap, that I reckon it will be the moſt common; it is that which I make uſe of at preſent.

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CHAP. VII.

Sixth Conſtruction *for ſuch Chimnies as can have no Cavities behind the Back.*

WHere you cannot dig in the Back-Wall of a Chimney, by reaſon of its Thinneſs, or on any other Account; then you muſt take the Cavities only in the Sides and under the Hearth; you may alſo make a Paſſage behind, or under the Mantle-Tree.

[*Fig.* 4] In this ſixth Conſtruction you need not make the whole Compaſs of the Chimney of one Piece, as in the other Conſtructions; you may have the Back as before, and only round the Sides according to the Model; cover thoſe 2 Sides from the Back C *c* to the Fore-part of the Jams A *a*, with Copper or Plate-Iron, and leave behind each a void Space 4 Inches deep;

divide thoſe Spaces each into two, by the Partition-Plates H I, *h i*, and with another Partition-Plate H *h* divide into two the Space under the Hearth, which is ſuppoſed to have been digged 4 Inches deep.

Now if the Air begins to come into the Cavities thro' D A H, and goes under the Hearth thro' A H *h a*, it will come up thro' *h a b i*, go down again thro' *i h c*, then (if there be no Cavity behind the Mantle-Tree) go into the ſecond Cavity under the Hearth *c h* H C, go up H C X, from whence it will go out to go into the Room thro' R, after it has acquired Heat in all the Cavities,

But if there be a Paſſage behind the Mantle-Tree, after the Air has paſſed from D thro' the Cavities H A *a h*, *b a i h*, it will go thro' *i g q* into the Canal *b e s*, S F B under the Mantle-Tree, go down from it thro' I X C H, to go into the ſecond Cavity HC *ch* under the Hearth, then to riſe into *c hx*, and ſo go into the Room thro' *r*; the Space A H I B being of no uſe, may be left full.

You ſee that this ſixth Conſtruction differs little from the firſt, third or fourth; and ſo that they may be uſed ſingly or combined, according to the Fancy of the Builder, the Make and Situation of the Place, or the Charges that any one will go to.

The Air may be made temperate in this ſixth Conſtruction, as well as in the others,

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CHAP. VIII.

Seventh Conſtruction *for Chimneys in great Halls, or Places to warm ſeveral People at once.*

THE Conſtructions given in the foregoing Chapters, are only for the Chimnies of common Chambers, or of Cloſets ; but for great Halls, and Fire-Places for Colleges, or other publick Societies, we muſt vary a little from the Proportions before laid down. In the great Chimnies of ſuch large Places, the Wood is burned whole, eſpecially where the Billets or Pieces are but 3 Feet and 8 Inches long, that they may go in quite to the Back of the Chimney, without being cut ſhorter : In order to make the Model A H C *c h a* [*Fig.*12.] you muſt firſt make C *c*, the Diſtance of the Sides at the Back of the Chimney, 5 Feet 8 Inches, and the Line A *a* 7 Feet or ſomething leſs ; we ſuppoſe it here of ſuch a Length, as is fit to determine the Opening of the Forepart of the Chimney, and the Length of the Mantle-Tree ; the Line A B and *ab* is 2 Feet long, being the Meaſure of the

Depth of the Chimney, and C G *c g* each of 5 Inches; the Lines A G *a g* muſt be drawn, and G H, *g h*, muſt be 7 Inches each; join the two Points C and H by part of a Circle, whoſe Center and Radius is found in the manner taught in the firſt Chapter, and you will have *cha* the Stroke or Line of the Model for thoſe great Chimnies; or elſe, if you would be ſo exact, you may make the Sides parabolical. The moſt ſimple Conſtructions are always ſufficient for theſe great Chimnies, becauſe the Cavity in the Back being higher and longer than in the common Chimney, it will contain a great Quantity of Air, of which only a ſmall part will go out each Inſtant; therefore there will always remain a great deal of warm Air, which will alſo warm the freſh Air that is conſtantly coming in; beſides, the Fire taking up more room, will conſequently give greater Heat to the Air in the Cavities, which muſt be made about 5 Inches deep, and the Paſſage where the Air comes come in, paſſes thro', and goes out, muſt contain about 80 ſquare Inches.

When theſe Chimnies are built for great Societies, you may, if the Place will allow it, have them in the middle of the Room, ſetting 2 of them Back to Back, ſo that there may be Fire on both Sides. The ſame Cavity may ſerve behind, being divided into Cells ; ſo that a Fire may be in either Chimney, and produce the ſame Effect ; and when it is in both, it will warm the Room faſter, becauſe it gives the Air much more Heat. If there be 2 diſtinct Rooms in common Apartments, whoſe Chimnies are Back to Back; inſtead of the uſual Back, an Arch may be ſo built, as to have one Cavity common to both, ſo as to give Heat to either Room, or to both at once, as you ſhall ſee fit.

* * *

CAHP. IX.

How to make the Air which comes into the Room Temperate, in what Degree of Heat or Cold you pleaſe. [*Fig.* 21. & 24.]

IF you would have the Air that comes into the Holes R or *r* to be ſometimes hot, ſometimes cold, and ſometimes temperate, by having both come in together, and by that means encreaſe or diminiſh the Heat of a Room, without encreaſing or diminiſhing the Fire ; near the Hole R or *r*, where the hot Air comes into the Room, there muſt be a Communication with the Paſſage *y*, from whence the External Air comes immediately in, before it goes into the Cavities ; and contrive the matter ſo, that what opens the Paſſage for hot Air to go into the Room, may ſhut out the cold Air, and ſo reciprocally; or elſe ſometimes open one, ſometimes the other Hole, or what part you will of either. This may be done ſeveral ways; here follows the Deſcription of ſome eaſy and ſimple Contrivances for that purpoſe.

[*Fig.* 14, 15, 20, 24.] Get two hollow Cylinders, like two round Boxes or Barrels, to turn one within another, the biggeſt being about a Foot Diameter, and 9 Inches high; make three openings in it, *viz.* *g l*, *m n*, *d p*, each 5 Inches wide, and 8 Inches high; the Space *l m*, which is 6 Inches wide, muſt be left full, as well as *n d* of 2 Inches, and the remaining part *p g*: In the leaſt or inner Barrel leave *q c* open 6 Inches wide, *b c* and *q y* full, being of 6 Inches each; let the remaining Part *y b* be open, and 8 Inches high; between *n* and *d* leave a ſmall part butting forward into the Opening *q c*, that as the little Cylinder turns about, it may ſtop when the Points *q* or *c*, ſtrike againſt it.

To fix this double Cylinder, place the Opening *n m* to the way of the warm Air from the Cavities; let *p d* be open into the Paſſage for the cold Air, and *g l* open towards the Chamber, as may be ſeen in the 20*th*, 21*ſt*, and 24*th* Figures; now when *y q* is over againſt *p d*, only the warm

Air, or that which has paſſed thro' the Cavities of the Chimney, will go into the Room; but if you turn *c* over againſt *n*, nothing but cold Air, or ſuch Air as comes immediately from without Doors, will come into the Room; for the Hole *m n* thro' which the warm Air came will be ſtopped; but if the Point *c* was only brought forward to the middle of the Hole *m n*, half of *p d* would be open, then warm and cold Air would go into the Cylinder, which would be mixed as they came out thro' the Hole *g l*; if you ſhut up but a third Part of *n m*, you thereby only open a third Part of *p d*, &c.

[*Fig.* 15, 21, 24.] That you may turn the inner Cylinder eaſily, at the End *o* of its Axis, you muſt fix a kind of an Hand *g o* that may come out in ſome part of the Chimney-Piece, or any where elſe in the Room, where you muſt draw an Arc that ſhews how far it muſt turn to open or ſhut the Holes of the Cylinders, and divide this Arc into Degrees, that as you turn the Hand, you may know whether the Paſſage is open for the cold or for the warm Air, or for both, and in what Proportion you let them mix as they come into the Room.

[*Fig.* 14, 15.] If you left full only the Space *c b* of the little Cylinder equal to *d m* or *n p*, you might ſucceſſively ſhut up the

3 Holes of the great Cylinder, or leave them all 3 open, or leave only as much of *pd* open as you have of *nm* ſhut.

[*Fig.* 16.] You might even take off part of thoſe 2 Cylinders, and leave only *p d n m*, of the great one, and *c b* of the little one, as you ſee in the 16*th* Figure; then you will not have occaſion for ſo much Room for this Machine, which is as exact, and much ſimpler than the other.

[*Fig.* 17. 18.] Join at right Angles, or ſquare to one another, 2 little Frames *p d*, *n m*; the Breath of each of the Holes *p d*, *n m* muſt be of 5 Inches; and the Height, which is repreſented in *fig.* 18. of 8 Inches; within the right Angle, at the Angular Point, fix a Shutter *c b*, which may alternately ſhut the Frames, which muſt be ſo plac'd, that one of the Holes may anſwer to the Paſſage of the Air from the Cavities, and the other to the Place where the External Air comes in immediately, as may be ſeen in the 20*th* Figure; inſtead of a Hinge you muſt have an Axis for the Shutter to play upon, with a Hand fixed to this Axis, by which you may move the Shutter; or if by reaſon of the Diſtance from the Axis to the Place where you can come to move the Hand, too great a Space would be deſcribed by the End of it, which deſcribes a quarter of a Circle; you may do it with a

Wheel on a Pinion made in what Proportion you pleaſe, to know at Sight in what manner the Holes are open, and have an Index which takes up but little room.

You may have two Shutters if you will made in ſuch manner, as to ſhut up, or open both Holes; or by fixing them at right Angles, to have one Hole open, when the other is ſhut; and then looſen them from each other, to make them ſingle Shutters as before.

If both Holes were in the ſame Plane, one Frame with a Board ſlidding in a Grove would do.

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CHAP. X,

Of the Vent-Hole, *or* Bellows. [*Fig.* 13, 21, 24.]

THE Vent-Hole, whoſe Uſes we explained in the foregoing Books, is as convenient, as it is ſimple. To a little Frame of Copper or Plate-Iron, whoſe inſide is about 3 Inches long, and 2 Inches and a half wide, or to ſuch an Hole made in the Hearth-Plate when there is one, fix with a Hinge a little Trap-Door *Z*, ſo that it may ſhut cloſe; and inſtead of rabbiting the Frame and Trap-Door, let both be bezelled or ſloaped, that no

Aſhes may lie on the Edge of the Frame, which would hinder it from ſhutting cloſe: on that Side which is oppoſite to the Hinge have a little Button that you may lift up with the Tongs; and if you will, the Button may have a Bolt fixed to the under Side of it, to open when you turn the Button; at the under Side of this Trap-Door, on each Side have a ſmall Portion of a Circle, or a Sector, whoſe Center is at that Part of the Trap-Door, where the Hinge is, that when you lift it up, the Wind may only blow directly upon the Fire; and that the Trap-Door may ſtand open at ſuch an Height as you think fit, fix a couple of Springs under the Frame, each of which muſt bear againſt the Limbs of the Sector-Pieces, and ſo keep the Trap-Door faſt at any Opening: This Trap-Door is repreſented under the 17*th fig.* When the Hearth is not covered with a Plate, Hooks or Staples muſt be fixed to the Frame, in order to faſten and ſeal it cloſe over the Hole made about 12 or 15 Inches forwarder than the Back of the Chimney for that purpoſe, and into which the External Air comes in at a little Canal, as *h z*.

BOOK III. PART II.

How to order the upper Part of the Funnel of the Chimnies, to hinder *the Smoke, to* increaſe *the Heat, and to be able to* put out *the Fire in the Funnel.*

HAVING in the foregoing Book mentioned the Contrivances at the Top of the Chimnies, we ſhall here fully deſcribe them. And in order to apply them more eaſily, care muſt be taken in ſuch Chimnies as are built New, to carry the Tops of their Funnels, ſo as to have their Sides touch in a Stack of Chimnies, that it may rather make a Parallelogram than a Square at Top: When there is occaſion for the ſecond Conſtruction, it will readily be fixed to ſuch Chimnies. If we would do without it, we muſt take care that the Chimnies be built ſo as not to be commanded.

CHAP. I.

Of the firſt Conſtruction *applied* outwardly *to the Top of the Funnel.*

THE firſt Conſtruction may perhaps not appear new, becauſe ſeveral Chimnies have ſomething like it; but ſince it is not univerſal, nor made in that juſt Proportion as it ought to have, and eſpecially becauſe it is part of the ſecond Conſtruction, we muſt give it here.

[*Fig.* 8.] Then ſuppoſing A *a*, the Length of the Hole at Top of the Funnel, to be 30 Inches in the Clear, that is, on the inſide, and its Breadth A B 10 Inches; ſhut in 2 Inches of it round about, in ſuch manner, that it may open ſloping within the Funnel, and thus your Hole will be but 26 Inches long, and 6 wide; divide that Length in C D; *c d*, by 2 Partitions of 4 Inches each, whoſe underſide muſt end in an Angle within the Funnel, and there will be left 3 Holes, each 6 Inches ſquare.

Make 3 truncated Pyramids, ſquare and hollow, whoſe Baſes in the inſide muſt be 11 or 12 Inches ſquare, and the Top 5 or 6; you muſt divide each of the Holes at Top into two, by a Partition 2 or 3 Inches deep; but every Hole muſt not be divided the ſame way, the pricked Lines in the Pyramids A E G D, DI M D, *d e g a* whoſe Height is 12 or 13 Inches; lay and fix theſe 3 Pyramids near one another, over the Holes A B C D, D C *c d*, *d c b a* of the Funnel of the Chimney, in ſuch manner, that the Letters of the Baſes may anſwer to the ſame Letters at the Top of the Funnel, the Line B A in the one, lying on the Line B A in the other, *&c.* This will be ſufficient for moſt Chimnies; but when it happens not to have the deſired Effect, you muſt make uſe of the ſecond Conſtruction, or rather finiſh the ſecond Conſtruction, of which this is but part.

If the Hole of the Chimney is leſs then we ſuppoſe, diminiſh the Holes of the Pyramids; and if it be bigger, increaſe them, or inſtead of 3 make uſe of 4.

Theſe Pyramids may be made of Plaiſteror Potter's Clay, baked like Earthen-Ware; or elſe you may make uſe of Tin, eſpecially when you would uſe the Capital, which we ſhall deſcribe in the next Chapter.

* * *

CHAP.

CHAP. II.

Of the ſecond Conſtruction *at the Tops of the Funnels of Chimnies.*

[*Fig.* 33.] THE Pyramids being made and fixed after the manner that we have mentioned, add the Capital, whoſe particular Pieces are as follows.

[*Fig.* 10.] The firſt and ſecond Piece are 2 Boards A H L M O B, *a h l mob*, (all the Lines marked in theſe 2 Pieces with the ſame Letters will be equal, and ſo it is enough to determine them in the one; or indeed when you have drawn and cut one, you may eaſily cut the other by it, by laying the firſt on to ſcribe it;) the Breadth of A B at Bottom muſt be about 13 or 14 Inches, as well as G B; the Height A G or B P, 8 Inches; G H or P O 6 Inches, as well as H I and O N; the Breadths H O and I N, 12 Inches; I L and N M, 8 Inches each, and L M, 5: Q R S is a Triangle where the Wood muſt be cut out; its Baſis Q S in the ſame Line as I N is 6 Inches; and the 2 Sides Q R, R S, 7 Inches each; A F E B ſhews the Place which muſt anſwer over againſt the Face A E F B of the Pyramid A E G D, when the Pieces [*Fig.* 8.] of the Capital are put together and fixed upon the Chimney.

[*Fig.* 10.] The third Piece S R Q *q r s*

muſt

muſt be a Plate of Tin 30 Inches long and 14 broad, which you muſt fold in the middle along the prick'd Line R*r*, to make a ſort of a Gutter, or a triangular Priſm, if you cover the upper part of it.

The fourth Piece GL*lg*, and the fifth Piece FM*mp*, muſt be 2 other Plates of Tin, each 32 Inches long, and 20 broad, indented along their Length, as you may ſee in the Figures, in ſuch manner that LT, UX, YZ, *&c.* ſhall be 5 Inches each, and the Lines TI, IU, *&c.* 7 Inches each; the pricked Lines H*h*, I*i*, O*o*, N*n*, mark the Places where theſe Pieces muſt be folded, when you nail them upon the 2 firſt; they are made of Tin as well as the third, rather than of thin Plate-Iron that is only black, becauſe the Rain will cauſe ſuch a Ruſt as will quickly eat thro' it.

To join all theſe Pieces together, ſet up perpendicularly the firſt Pieces one over againſt another; and at 30 Inches Diſtance one from another, that is at a Diſtance equal to the Length of the Hole of the Chimney; in theſe 2 Pieces fix the third by its Ends, which you muſt thruſt into the Triangular Holes QRS, *qrs*, folding it as far as the Hole requires; then you may join alſo to them the fourth and fifth Pieces, folding them as much as is neceſſary to have their Ends GHIL, *ghil*, PONM, *ponm*, reſt upon the Edges of the 2 firſt, beginning from G P, *g p*, [*Fig*. 8, 9.]

All theſe Pieces being thus joined together, you muſt fix them above the 3 Pyramids, in ſuch manner, that the Line R *r* of the Piece which is a Triangular Priſm, may lie over the middle of the upper Hole of the 3 Pyramids, which need not be divided here: The Ends A B *a b*, of the 2 firſt Pieces, are to reſt upon the 2 Sides A B *a b* of the Funnel of the Chimney; faſten and ſeal the Hole very well when it is in this Situation, and you will have the ſecond Conſtruction.

If you would not make the 2 firſt Pieces of Wood, for fear of Fire, or wearing out too ſoon, make only the Model of Wood, that by means of it, you may on each Side raiſe a Wing of Plaiſter upon A B *a b*, and ſo fix and ſeal on the Sides, and in the Middle, the third, fourth and fifth Pieces in the manner that we directed to fix them to the Wood.

If you had rather make the Hole of Tin, as well as the truncated Pyramids, you may carry the whole Machine ready fitted to the Top of the Chimney, where you may fix it without any Trouble, and be ſure that it is tight.

CHAP. III.

Of the Conſtruction *of the* inſide *of the Funnels of Chimnies, in order to* put out *the Fire that might catch there, to* keep in *the Heat in a Room all Night long, and to hinder the Smoke of a Neighbouring Chimney from coming in; and alſo concerning the Inſtrument for covering the Fire.*

THE Regiſter Plates for putting out the Fire in the Funnels of Chimnies, keeping the Room warm all Night, and hindering the Smoke of a Neighbouring Chimney from coming into yours, which often happens when your own Fire is out; and the Cover-Fire Inſtruments, are of ſuch common Uſe, that what we have ſaid of them in the *firſt Book* might ſuffice; but that we may not be wanting in our Directions to the Workmen, we will here deſcribe them more particularly.

[*Fig.* 5, & 7, 25.] Two thin Plates of Iron ST *ts*, [*Fig.* 5, 25.] NO *on*, *fig.* 7. exactly as long and as broad as the Hole of the Funnel of the Chimney is where you deſign to have them, are ſufficient for the inſide of the Chimney.

The firſt Plate ST *ts* muſt have in the Middle of its Breadth a ſmall Axis at *p* P, whoſe 2 Ends at P*p* muſt ſtand out about an Inch or two; and there muſt be two Wires U M, *u m*, fixed to the middle of thoſe 2 Ends U *u*, that you may keep it in what Situation you think fit.

[*Fig.* 7.] The ſecond Plate N O *o n* muſt have its Axis N O, or N *n* at its Ends N *n* or N O, and a ſtiff Iron Wire I H fixed to the Middle I, to put it up or down as you ſee fit.

[*Fig.* 5, or 25.] To fix the firſt Regiſter Plate, in 2 oppoſite Places of the Funnel within 2 Feet of its Hole at Top, make 2 Holes P *p* [*Fig.* 4.] over-againſt one another; in the Middle of the Breadth of the fore and back-part, put in 2 Iron Eyes for the Ends of the Axis to play in, and make 2 Ledges in the Chimney, in ſuch manner, that the Plate may go no further when it ſhuts cloſe; bring the Wires U M *u m* down the Funnel into the Chamber, where they muſt be faſtened that you may eaſily come at them, to open or ſhut the Regiſter Plate.

Inſtead of little Ledges in the Funnel to keep the Regiſter Plate tight, when it is brought down to a level Poſition, you may make it a little longer than the Hole of the Chimney, and then it will be cloſe ſhut, before it be brought quite down to an Horizontal Poſition.

[*Fig.* 7 & 26.] To fix the ſecond Regiſter Plate N O *on*, you muſt alſo make 2

Holes in the 2 Corners of the lower-part of the Funnel of the Chimney, to let in the 2 Ends of the Axis N *n*, or N and O, according to the eaſieſt way of opening it; the beſt way being to have it play upon N and O let into the Corners, that when it is open, it may be flat to the Chimney, where the ſtiff Wire or long Hook H I, will keep it, by putting the End of the Hook in an Eye at H.

As to the Fire-Cover, which may be of Copper, Braſs, Plate-Iron or Tin, it is ſhaped like a Box without a Cover, about 2 Feet long, 10 Inches wide, and 6 deep, with a Loop to move it eaſily: If it be of Tin, the Plates muſt be rivetted as well as ſoldered, or elſe the Fire would ſoon make them fall from each other.

The 2 Regiſter Plates being fitted within the Chimney, if the Chimney ſhould be on Fire, take the Coals out of the Hearth, and ſhut down the 2 Regiſter Plates, as we have ſhewn, by pulling the Wire M U, (*Fig.* 4 and 8.) of the upper Plate, which ſerves for that Uſe; and the Hook I H (*Fig.* 26.) of the lower Plate, and the Fire will go out immediately; it would go out tho' you ſhould ſhut down but one of the Regiſter Plates, but not ſo ſoon; and then you would be troubled with the Smoke till the Fire was quite out, tho' you might, to avoid that, throw

Water upon the Fire in the Hearth, whoſe Vapour would help to quench the Fire in the Funnel, and ſhut up the fore-part of the Chimney with a wet Cloath, or any thing elſe; but if you have two Regiſter Plates, the beſt way is to ſhut them both down.

By ſhutting down the upper Regiſter Plate, you will keep out the Smoke of a Neighbouring Chimney, which is often blown down yours when you have no Fire; by this means you may keep the Warmth in your Room all Night, but then take care either wholly to put out your Fire, or at leaſt to have no ſmoking Coals.

If you rake up the Fire together on the Hearth, and put the Cover over it, ſo that no Air comes under it, the Fire will ſoon be put out; but if you would keep in the Fire all Night, cover the burning Coals with the Aſhes, and put what Wood is left unburned over them, and lay on the Cover ſo that a little Air may go under it, then the Fire will be kept in without conſuming much: In ſuch a Caſe, the beſt way is to let down neither of the Regiſter Plates, but to cover the fore-part of the Chimney to keep *out* the cold Air, and keep *in* the warm.

BOOK III. PART III.

CHAP. I.

Of the Effects and Properties of the New Chimnies, *and how to make uſe of them.*

N. B. It is not enough for the Workmen to be able to make all the abovementioned Works, unleſs they alſo know the Uſe of them, which will be a means to make them the more perfect, and enable them to give an Account of their Advantages to thoſe Gentlemen whom they make them for. And we muſt be obliged to repeat ſomething of what we ſaid in the *Firſt* and *Second* Books.

BY means of our *New Chimnies* you may, 1*ſt*. Kindle a Fire very ſoon; ſee it always flame, without being obliged to blow it; and without confining your ſelf to the Uſe of ſmall Wood, make uſe of the biggeſt Billets, and even green Wood. See the *4th Chapter.* of *Book* 1 *Part* 1.

2dly. Warm a great Room with a little Fire in a little time, and ſometimes the next Room to it. *Chapter.* 2 and 3, *Book* 1 *Part* 2.

3dly. Encreaſe or diminiſh the Heat of a Room, without encreaſing or diminiſhing the Fire. *Chapter.* 3. *Book* 1. *Part* 2.

4thly. Warm your ſelf on all Sides at once, without burning your Legs, Eyes or Face; and ſo avoiding all the Inconveniences that attend very cold Weather. *See the ſame Chapter.*

5thly. Hinder the cold Air from coming in under Doors or thro' Crannies; and make that little which may come in, be thoroughly warm before it comes to you, if you are at ever ſo ſmall a Diſtance from the Windows or Doors where it comes in. *The ſame Chapter.*

6thly. Bring warm Air upon your ſelf at any Diſtance from the Fire, without being obliged to go near it. *The ſame Chapter.*

7thly. Warm your Bed even whilſt you are in it, without any Danger of burning you; and cauſe warm Air to be blown upon any Part, ſo as to keep it warm. *The ſame Chapter.*

8thly. Conſtantly breath freſh Air, of what Degree of Heat you pleaſe; ſo as not to dry or offend your Lungs. *The ſame Chapter.*

9thly. Drive all the Air out of a Room in a little time, and cauſe it to be ſucceeded by new Air heated to any Degree in the coldeſt Seaſon, and dryed in the moiſteſt; and thereby prevent the Inconveniences and Unwholſomneſs of ſtagnating and vitiated Air, ſuch as is commonly in a Room where any Body is ſick. *The ſame Chapter, and Chap.* 4.

10thly. Have your Room ſo dry, that your Goods will not be damaged, during the greateſt Fogs, or when it thaws ever ſo faſt. *The ſame Chapter.*

11thly. Keep a Room warm all Night, tho' the Fire is put out. *Chapter.* 1, 2, 3. *Book* 2, *Part* 3.

12thly. Never be troubled with Smoke, which offends the Eyes, cauſes Diſtempers, and ſpoils your Linnen, *&c.* *Book* 2.

13thly, By your ſelf, and in an Inſtant, put out the Fire that may chance to catch in the Funnel of your Chimney. *Chapter* 2. *Book* 1. *Part.* 3.

14thly, Hinder the Smoke of a Neighbouring Chimney from blowing down into yours. *The ſame Chapter.*

And Laſtly, make ſeveral Chymical Operations.

CHAP. II.

How to make uſe of the New Chimnies

[*Fig*. 6, & 24.] TO kindle the Fire in theſe Chimnies, take a lighted Charcoal, or a Piece of Paper, and ſetting it between 2 or 3 Sticks, open the Bellows, and all the Wood will quickly be on Fire.

As the Bellows or Vent-Hole blows ſo much the ſtronger, as there comes leſs Air into the Room otherwiſe; when the Wind does not blow, or the Weather is not very cold, you may ſhut up the other Paſſages where the Air comes in; that is, if the Room does not ſmoke, otherwiſe it would be better to leave them open, and wait a little longer for the burning of the Fire.

[*Fig*. 6, 21, 24.] When the Weather is very cold, the Wind comes always violently into the Hole R, which opens into the Room; ſo that before the Cavities of the Chimney be warmed, it comes in very cold, therefore you muſt ſhut up R at firſt, unleſs by ſo doing, the Room ſhould ſmoke: And in that caſe you muſt take care to make the Flame ſtrike againſt the Back, ſo as to warm the Plate in the ſecond, third and fourth Conſtructions, and likewiſe to cauſe it to paſs underneath, and ſo behind in the fifth, that the Air in the Cavities may be ſoon warmed; and to haſten this, you might ſhut up part of the Hole D, thro' which the External Air comes into the Cavities; for the leſs of it comes in, the faſter it will be heated; but you muſt always let in enough to hinder the Smoke: And if the Room did not ſmoke (as it will happen to moſt Chimnies, eſpecially at certain Seaſons) tho' the Hole for the External Air ſhould be wholly ſhut, it would be well to leave it ſo for a while, till the Cavities behind the Back were heated. After any one has made uſe of theſe Chimnies a little while, Experience will teach the Management of them much better than all the Inſtructions I can give.

When you find the Room warm enough, and you would not have the Heat encreaſe any more, tho' you are unwilling to leſſen your Fire, you muſt ſhut up the Hole R, [*Fig*. 6, 21. 24.] where the warm Air comes in; and if you would have the Heat diminiſh, open *pd* the Entrance for cold Air, and ſhut *nm*; if you would give the Air that comes in, different Degrees of Heat or Cold, leave part of each Paſſage open, more or leſs as you ſee fit.

When you put out the Fire at Night, or in the Day-time, always take care (eſpecially when the Weather is very cold) to ſhut up D, where the External Air comes in, for otherwiſe the Room would quickly be cold; nay it will be proper during the whole Night to let the Fore-part of the Chimney be wholly ſhut up; or if the Coals ſmoke no more, it will be enough to ſhut down one of the Regiſter Plates, if you have any, that no cold Air may come in that way, whilſt the hot Air goes out.

Now as the Hole R, where the External Air comes in after it has acquired Heat in the Cavities, muſt be big enough to ſupply as much Air as will hinder the Room from ſmoking; you may ſhut all the other Places where Air might come into the Room, as well about the Doors as the Windows; and that as ſmall a Quantity as may be, may go in when the Door is opened or ſhut, it will be proper to have a double Door, one of which muſt be always ſhut before you open the other; but this is only neceſſary in very ſevere Winters, tho' it is always uſeful.

If you cannot have a Vent-Hole, *or will not always make uſe of it to light your Fire, you muſt have a Pair of* Bellows *that blow conſtantly, whoſe Deſcription I ſhall not give from* Monſieur Gauger; *becauſe they are become very common, and may be had at ſeveral Bellows-Makers, being made according to Captain*

Captain Savery's *Method, which is better than the Author's Way.*

CONCLUSION.

If what has been advanced in this *Treatiſe*, ſhall bring theſe *New Chimnies* into vogue; and leſſen *mere Speculative Enquiries* by promoting *uſeful Mechanics*, it will then have had its deſired Succeſs.

* * *

An Explanation of the Figures.

THE Figures 1, 2, 5, 7, 12, 13, 14, 15, 16, 17, 18. need no other Explanation, then what is given in the Chapters, where they are referred to.

The *Third Fig.* repreſents the Profil of a Chimney, cut by a Plane perpendicular to the Hearth and to the Back.

Z, is the Trap-Door of the Vent-Hole or Bellows; and *x* its opening when it blows.

F, the Place where the Fire is.

T *t*, the Aſh-Hole, and below it the Cavity under the Hearth.

S GA, the Cavity behind the Back of the Chimney.

o i m, the Horizontal Plane under the Mantle-Tree, as we would have it.

I, the Cavity or Paſſage under the Mantle-Tree.

m L N R, The Funnel of the Chimney.

o R, the Line which denotes the Slope of the Breaſt, where the Space *o m* R is wholly void, as in common Chimnies.

The Upper-Part of the *Fourth Fig.* is the Profil of the Funnel of the Chimney, with the Pyramids and Capital above them, and the Regiſter Plate within; the Section being made by a Plane paſſing thro' the Axis of the Priſm R*r*.

The *Sixth Fig.* repreſents a Chimney quite finiſhed, whoſe Sides or Jams are parabolical.

A H C *c h a* A, is the Hearth.

Z, the Vent-Hole with its Frame.

K T *k t*, the Aſh-Hole.

O D F I L, the Back with the thick ſtrong Plate framed in before the thin Plate, to hinder the Wood from burning the thin Plate, when there is a Cavity behind the Back for the paſſing of Air.

D*d*, the Door for the Air to go into the Cavities.

R*r*, the Doors of the Holes where it muſt come out again.

g, the little Hand to turn the Cylinder or Shutter, which opens or ſhuts the Air's Paſſage.

P, a Paper hanging by a Thread before the Hole *r*.

The *Eighth Fig.* repreſents the Upper-Part of the Funnel of the Chimney, with its 3 Pyramids above, whoſe lower Parts we have left uncovered, to ſhew the Holes of the Funnel.

T *t s* S, in the Regiſter Plate, which muſt be fixed ſo as to play in the Place where it is drawn, in order to put out the Fire that might catch in the Funnel; P *p*, are the Pivots upon which it turns; V M, *v m*, part of the Wires which ſerve to open and ſhut it; it is here repreſented ſhut, but the pricked Lines repreſent it opened. The fore-part of the Funnel has been left open, to ſhew this Plate.

The *Ninth Fig.* is the Capital, which it is ſometimes needful to fix above the 3 Pyramids; it muſt be ſo fixed as to reſt upon the Upper-Part of the Funnel of the Chimney, A B of the Capital lying upon A B of the Funnel, and *a b* upon *a b*, the Surface H G *g h* covering part of the Pyramids, and the Line R *r*, reſting on the Top of the Holes of the Pyramids.

The *Tenth Fig.* ſhews all the Pieces of the Capital by themſelves.

The *Eleventh Fig.* is a Profil of the Upper-Part of the Funnel, of the Pyramids, and of the Capital; all cut by a Plane perpendicular to the Thickneſs of the Funnel, or to the Axis of the Priſm SQR.

P *p*, in the Funnel are the Holes where the Centers or Ends of the Axis of the Regiſter-Plate muſt play.

A F F B, is one of the Pyramids.

Q R S, the Section of the Priſm above them.

G H I L M N O P, the Section of the Capital which covers them.

In this Profil you may ſee how eaſily the Smoke can come out of the Chimney, and how hard it is for the Wind to blow down into it.

The *Nineteenth Fig.* is the Geometrical Plan of the fourth Conſturction of the Chimney, which is repreſented by the *Twenty-fourth Fig.*

A H C *c h a*, is the Hearth.

Z, the Cavity under the Vent-Hole or Bellows.

H Z, the Canal or Paſſage for the Air to come into it.

K T *k t*, the Aſh-Hole.

H M, C N *c n*, *h m*, the lower end of the Partition Plates, which part the Cavities.

H M C N, C N *n c*, *n c m h*, the Baſes of the 3 Cavities behind the Sides and Back of the Chimney.

D *y*, the Channel for the Air to come into the firſt Cavity.

The *Twentieth Fig.* is an Horizontal Section of the ſame Chimney, immediately under the Mantle-Tree.

B *b*, is the lower Edge of the Mantle-Tree.

B E *e b*, the Lower-part of the Paſſage under the Mantle-Tree.

E X *x e*, the Hole of the Funnel of the Chimney.

d p I, the Paſſage for the Air to get up under the Mantle-Tree.

d p i, the Paſſage for the Air to come down from it.

X O *o x*, the Upper-part of the Cavity where it comes up behind the Back.

X O *m*, *x o m*, the Lower-part of the Ways of it into the Room.

m n l g, the Baſis of the Cylinders thro' which the Air comes in.

m p n, the Square with the Shutter, which ſerves for the ſame Purpoſe on the other Side.

X O, *x o*, the Upper-part of the Partition-Plates.

If you ſuppoſe this Plan over the former, (*viz.* the 19th *Fig.*) you will have the Chimney as it is, and as you ſee it in the 24th *Figure*.

The *Twenty-firſt Fig.* ſhews the fifth Conſtruction of a Chimney, with the Fore-part of the Back taken off from H to *h*, as alſo the Middle-part of the Mantle-Tree, and the Bottom of the Breaſt, to ſhew all the Back-part of the Chimney within, or the inſide of the Box of caſt

Iron, where the Air paſſes winding as the double Lines ſhew.

A H C *c h a*, is the Hearth.

Z, the Vent-Hole with its Frame.

H Z, the Paſſage from the Air to come to it.

Z *a h p*, the Paſſage to carry the Air up to the Cylinder.

C G *g*, F E *e*, H *h* L, *x m* M, the Partition Plates fix'd to the Back-part of the Box.

The Line C T *t c*, ſhews the Height that the Box muſt be plac'd above the Hearth, and N *l n* the prick'd Line beyond, ſhews the Space that muſt be between the Back of the Box and the Back of the Chimney; but you may ſee it better expreſs'd in the 26th *Fig.*

v v v, the Holes where the Air and Heat go out from behind the Box.

g l m n, is the Cylinder thro' which the Air goes into the Room, which may be placed on the other Side, as well as where it is repreſented, as it ſuits beſt with other Conveniencies.

The winding Lines in the *Twenty-ſecond* and *Twenty-third Figures*, ſhew the way of the Air in different Conſtructions of Chimnies.

The *Twenty-fourth Fig.* repreſents the 4th Conſtruction of a Chimney, the Plate of the Back being taken off from H I to *h i*, to ſhew the Partition-Plates, and the Paſſage which they make behind the Plate and the Way of the Air repreſented by the white Lines. The Mantle-Tree is alſo taken off from B to *b*, and the Canal or Paſſage behind it from E L to *e l*, to ſhew the inſide behind the Back, and the Way of the Air from without Doors, round thro' all the Cavities into the Room.

A H C *c h a*, is the Hearth hollow underneath.

Z, the Vent-Hole or Bellows.

K T *t k*, the Aſh-Hole.

A B I H, *a b i h*, part of each Side.

H I X C, C X *x c*, *c x i h*, the 3 Cavities of the Bottom and Sides laid open.

X O N C *x o n c*, the 2 Partition-Plates which divide the Cavity into 3 Cells.

B E S L, *b e s l*, the 2 Sections of the Paſſage under the Mantle-Tree.

l m n g, the Upper-part of the Cylinders.

m n, the Hole where the warm Air comes in; *p d*, that where the cold Air comes in; and *g l* is the Paſſage of the Air into the Room thro' R.

D, the Hole thro' which the Air goes into the firſt Cavity.

The Arrows ſhew where the Air goes upwards, or downwards, or horizontally; ſo that which is above I, ſhews, that the Air in that Place goes out of the firſt Cavity into the Mantle-Tree Canal, to go towards the other End of it *i*, where the other little Arrow ſhews that it goes in again in that Place to come out between *g* and *q*, and go down the Cavity *i x c*, as the Arrow there points; and then under the Hearth, whence it comes up the middle Cavity, and at laſt goes quite out to the right Hand, or to the Left, or both Ways at once.

The *Twenty-ſixth Fig.* is the Profil of the 5th Conſtruction of a Chimney, cut by a Plane perpendicular to the Hearth and Back.

Z, the Bellows, *x* its Opening.

K T, the Aſh-Hole.

L T V, the Thickneſs of the Box, behind which you may know what Space ought to be left.

I C the Regiſter Plate at the Entrance of the Funnel, and H I, its Hook which keeps it up.

o i m, the horizantal Plane under the Mantle-Tree.

The *Twenty-ſeventh Fig.* repreſents the caſt Iron Box for the 5th Conſtruction, the Fore-part being taken off, to ſhew the Cavities and Partitions.

The *Twenty-eighth Fig.* ſhews all the Pieces of the Box.

The *Twenty-ninth Fig.* is the Geometrical Plan of the 5th Conſtruction.

A H C *c b a*, is the Hearth which is not hollow underneath.

Z, the Bellows.

H Z, the Paſſage for the Air to it.

C N *n c*, the Hollow to place the Iron Box in. The Diſtance between N *n* and the prick'd Line, ſhews the Space that muſt be left behind the Caſe when it is laid.

H P N C, *h p n c*, are the Baſes of the two laſt Cells when there are five.

Some Obſervations. By Dr. *Deſaguliers*.

MOnſieur GAUGER having directed us to uſe Plates of Iron, Braſs or Copper, to line the Chimnies, and make the Cavities behind them; I had a mind to know whether the External Air which warm'd it ſelf in ruſhing through thoſe heated Cavities, did not bring along with it unwholeſome Particles of the Metal into the Room: For that Reaſon I got three Cubes of the three different Metals, one of Iron, another of Copper, and another of Braſs, each of them weighing 5. Pounds. I drill'd an Hole into the middle of each of them, about an Inch and an half deep, and a quarter of an Inch in Diameter, as is repreſented by *h o*: (*Plat.* 4. *Fig.* 30.) Then having exhauſted the Glaſs Receiver of an Air Pump of its Air, I took the Iron Cube (which had been heated by blowing under it in a Charcoal Fire, ſo as to look almoſt white,) and ſetting it upon a Brick B *b*, I thruſt the End *h* of the Pipe that came from the top of the Receiver R into the Hole *h o*, then turning the Cock C which opens into the Receiver thro' the Braſs Plate P *p* that covers it, all the Air which came into the exhauſted Receiver to fill it again, ran firſt into the Hole *h* by the Sides of the Pipe C T *h*, till it got to *o*, where coming into the Pipe, it went along *h* T C into the Receiver, carrying along with it the Steams of the Iron, till the whole Receiver was fill'd with this burn'd Air. Immediately I lifted up the Plate P *p*, and putting a Bird into the Receiver, I ſhut it up again, and the Bird liv'd there half an Hour, without the leaſt ſign of being ſick: Then making the ſame Experiment with the Copper Cube, a Bird was likewiſe unhurt in Air burn'd by that Means, and impregnated with the Steams of the Copper. But when I heated the Braſs Cube till its Corners began to melt, and made the ſame Experiment with it, the Bird began to have Convulſions in half a Minute, and in half a Minute more died.

N. B. The Pipe was of Braſs, only the end of it from T to *h* was of Iron, leſt the Heat of the Cube ſhould melt it, A *a* is the Plate of the Air-Pump upon which the Receiver ſtood. The Birds were

Linnets, but the ſame Bird was not put in twice.

I made the Experiment a ſecond time with the Braſs Cube, without having blown under it, only letting it have a degree of Heat equal to the common Heat of the Fire; and in that caſe the Bird ſeem'd no way affected with the Steam of the Braſs. The reaſon of this Difference I take to be, that there is a great Degree of Heat requir'd to cauſe a Separation of the arſenical Parts of the *Lapis Calaminaris*, which enters into the Compoſition of the Braſs.

From the Conſideration of thoſe Experiments, it appears adviſeable not to make the Back-Plate, or line the Cavities of the Chimney that are moſt heated, with Plate-Braſs; tho' we may ſafely uſe Iron or Copper. If we would uſe Braſs, we may line the Jams or Sides with it, or ſuch Places as are not very much heated.

Secondly, When the Author gives Directions about the curing of the Smoaking Chimnies, he mentions the *North Wind* as blowing down Chimnies; but what he ſays is only for *Paris*, and ſuch Places that have the Sea on the North ſide. Such Eddy-Winds (as they are call'd) blow from the *South* when we have them here at *London*; and generally ſpeaking, in all Places we may expect that Wind to blow down the Chimnies, which comes from the Sea; I mean when Chimnies are not commanded; for in ſuch a Caſe there may be Circumſtances that will make the Wind blowing from any Point to go down a Chimney; but otherwiſe we muſt prepare againſt the Wind blowing from the neareſt Sea.

The Conſtruction *of a* Chimney *in which* Turf, *or* Peat, *is burnt.*

IN Chimnies where you burn Wood, the Cavities behind the Back and Sides, after the manner that the *French* Author directs, are very uſeful; but where you have your Heat very ſtrong, but leſs diffus'd, it will be proper to make the Cavities as near the Fire as poſſible; and tho' the Way of the Air wou'd be ſhorter, yet the greater Heat given to the Air in that Caſe, will make amends for the Swiftneſs of its Paſſage. This is what we have endeavour'd to do in this Conſtruction of a Chimney to burn Turf; and in the next Conſtruction for a Chimney to burn Coal.

[*Plate* 9. *Fig.* 1, 2, 3.] The Shape of the Chimney and Model of it K A Y *e f k* are as in our Author; but here we have no Cavity under the Hearth, only we have a ſort of divided Box of Plate Iron upon which the Fire lies, and an horizontal Cavity behind the Back, fac'd with Plate Iron, ſo low that the Fire lies againſt it; and from thence the Air is carried up a Paſſage in the Brick-Work in one of the Corners as high as the Mantle-Tree: From the Corner it is brought forward in the Side quite to the Canal of Tin under the Mantle-Tree, from which it is convey'd into the Room. The whole Mechaniſm of it will be eaſily underſtood by a ſight of the Figures.

[*Fig.* 1.] Repreſents the horizontal Section of the Box or Cavities upon which the Fire lies.

D Y is the Entrance for the External Air in the 3 Figures.

a Y E *e* B is the firſt Cavity, whoſe Height E A *Fig.* 2. is equal to the Breadth *a* B of ſix Inches, and Depth E *a*, 18 Inches; which is the common Depth of all the Cavities, five Inches of them going into the Wall as far as E F G *h* beyond the Back.

B C is the Breadth of the ſecond Cavity, *viz.* ſeven Inches, its Height C F (*Fig.* 2.) being only 5 Inches.

C *c* is the third Cavity 4 Inches high; and 9 broad. *c b* is the fourth like the ſecond, and *b a* the fifth like the firſt: The Partition-Plates B *e*, F, *f c*, and G leave a Space of 6 Inches from the Wall, or from the Fore-part of the Box as it appears in the Figure. You ſee then that the Cavities are nearly equal every where to 36 ſquare Inches.

B

B *b*, is a Fender which is to be put on upon A *b*, in ſuch manner, that the Pins under the Knobs may fall into the Rings B *b*.

The double Lines repreſent the Way of the Air under the Cavities as far as H, where it goes up towards *h*, as you may ſee in,

[*Fig.* 2.] Which repreſents a fore-right View of the Cavities and Back.

E *g h* I D, is the horizontal Cavity in the Back, the Bottom of which being of Plate Iron, reſts upon E *e* and G *g* the firſt and laſt Cavity under the Fire, and the Fore-part is alſo a Plate of Iron at F I *h g*.

This Canal is 7 Inches high, and 5 deep into the Back.

D E I K L, is the Canal in the Brick-Work that goes up from the laſt over D I E Y of *Fig.* 1.

L *k* M R, is the Section of the Paſſage brought forward in the Side from the top of the laſt Canal, into the Canal under the Mantle-Tree, here repreſented by M K N O, and in no wiſe differing from that mention'd by the *French* Author. If you have not a Canal, the Air may go out at R.

[*Fig* 3.] repreſents the Section of this Chimney, by a Plane perpendicular to the Hearth and Back, where D Y repreſents the Entrance for the External Air, as it does in all the other Figures.

E A Y, the firſt Cavity under the Fire.

D H I, the Section of the horizontal Canal in the Back.

H I K L, the Paſſage in the Brick-Work in the Corner or Angle, whoſe Section muſt be 36 Inches, whether it be ſquare or oblong.

L K M N, the Paſſage in the Side from the Back to the Canal under the Mantle-Tree, whoſe Section here repreſented is N O M.

N R the Way of the Air into the Room.

The double Line repreſents the Way of the Air where the Figure allows us directly to ſee it; and the ſingle Lines winding, ſhew where Cavities face us endwiſe.

Tho' I have not repreſented the Bellows here, becauſe ſome Peat don't need it; yet where a great deal of Air is requir'd to make Turf burn, as ſome ſort of Turf won't burn without; then not only the Bellows is to be us'd, but the Cavity F *f* C (*Fig.* 2.) is to be ſunk into the Hearth, its Top F *f* being carried down to C *c*, and an Iron Grate fix'd in the Line F *f*, thro' which the Aſhes will fall upon the ſaid Cavity and warm it. After the Fire is lighted and blown up, the Fender (whoſe Height is 3 Inches) may be put in, and its upper part will be in the prick'd Line E *c* G *g*.

Con-

Conſtruction *of* Chimnies *for* Coal-Fires.

AS Coal is the common Fuel of *England*, I reckon this Conſtruction will be beſt lik'd, and moſt us'd, eſpecially ſince the Charge of it will ſcarce be double the Price of a Stove-Grate. The whole Matter is a Grate of a particular Make, with a Box of Plate Iron behind the Back, that has only three Cavities, from which a Paſſage goes obliquely to the Corner in the Brick-Work, from whence it is brought forward in the upper Part of the Side, quite into the Canal under the Mantle-Tree, as in the laſt Conſtruction.

[*Fig.* 4.] Repreſents a Section of this Chimney, by a Plane perpendicular to the Back and Hearth.

D Y, The Entrance of the External Air to go to the Bellows Z, by a Paſſage under the Hearth, and alſo for the Air to go up behind the Grate into the three Cavities, one of which is repreſented by Q D H I.

H I L, Is the oblique Way to the Corner made in the Brick-Work, which is better repreſented by the ſame Letters in *Fig.* 5.

L K M N, The Way from the laſt into the Canal under the Mantle-Tree, whence the Air goes into the Room thro'

R *s r* S, the Grate made convex, that the Bellows Z may blow more fully upon it, the Wind from the round Cavity under Z being directed full againſt it.

s T, *r t*, Are the two Bars which come from each ſide of the Grate quite behind, to hold the Box of Plate Iron together, by means of another Bar T *t*, which is fix'd to the two former by means of the Keys T, *t*.

The fifth *Fig.* repreſents the Grate ſeen from before the Chimney.

D Y, The Entrance for the External Air.

D *d y c*, A thin Plate of Iron 8 Inches broad and 9 high, fix'd to the Back of the Grate, and let down an Inch into the Hearth, as a Means to bring the External into the firſt Cavity *d* E F, which goes into *d* D *y c*. This Plate is alſo repreſented in *Fig.* 10. tho' here it is ſuppoſed cover'd with Plaiſter of the Thickneſs of the Back of the Grate.

H I *i h*, Is another thin Plate 8 Inches ſquare, likewiſe fix'd to the backſide of the Back of the Grate in order to begin the Cavities H I L, which may go deeper into the Back, than ſuch Cavities as are cover'd with a Plate; Mortar being laid over the Plate H I *i b* to make all tight. The ſame Plate is repreſented by *Fig.* 11.

K N M L, The Section of the Paſſage along the upper part of the Side from the Back to the Canal under the Mantle-Tree.

N M O, The Paſſage under the Mantle-Tree.

Y Z, The Paſſage of Air to the Bellows.

B*b*, The Fender, which is ſet upon the Trap-Door of the Bellows when you don't blow; but backwarder where the prick'd Line is, when you blow.

C *f*, *c* D, The two Feet of the Grate which come directly from the Back of the Grate, and touch the Back of the Chimney. P *s*, *p* S, The two other Feet which are forwarder, as ſtanding under the bended croſs Bars R *s*, S *r*, which hold the main Bars together.

T *c t*, *f s* Q S D, the upper and lower main Bar, which as well as the others, are bent into an half Oval.

F *d* D S Q *s*, A ſmall Bottom-Grate for the Aſhes to fall thro'.

The winding double Line, ſhews the Way of the Air, and the ſingle Line, which takes two or three Turns, ſhews the ſame in ſuch Cavities as are ſeen end-wiſe in all the Figures, which compared together explain one another.

DIRECTIONS *for the* WORKMEN.

TAKE a Plate of Iron 2 Foot long, and 18 Inches broad, and ¼ Inch thick (*fig.* 6.) and cut off the upper Corners at F and I, ſo as to make it of the Shape repreſented in the Figure. Then rivet to the Backſide of this thick Plate, the two thin Plates H I *i h*, and D *d* Y *y*, before deſcrib'd, and you will have the firſt Piece.

The Partition Plates muſt be as thin as may be, ſix Inches broad, and fix'd edge-wiſe to the great Plate againſt the Lines *e* F G H D, and E *d f* I; they are ſeen edge-wiſe in *fig.* 7. ſo that if you imagine the ſixth Figure laid upon the ſeventh, you will have the ſecond Piece.

D F G H *e* (*fig.* 7.) Is the firſt of theſe Partition Plates, which may alſo be ſeen in *Fig.* 8. where the prick'd Lines repreſent the folding Places, where the Plates muſt be bent into Angles equal to F, G, and H in *Fig.* 7.

E d f I, (*Fig.* 7.) Is the ſame as the *Fig.* 9. where the Letters denote the Plate and its Folding-places, as before.

[*Fig.* 12.] Shew the Box ſeen from behind, cloſed up with a thin Back-Plate F T D *d t*, which Plate is held on by a Bar T *t* key'd on to two little Bars on the Sides, ſuch as *t* T.

The Plate D *d y* Y, behind which the Tube comes, to bring in the external Air, ſupports one End of the Box, while the Foot C ſupports the other.

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APPEN-

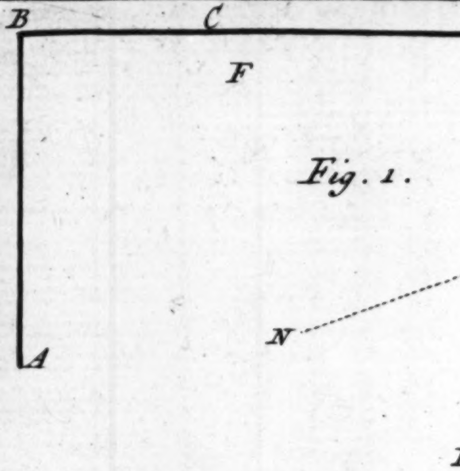


Fig. 1.

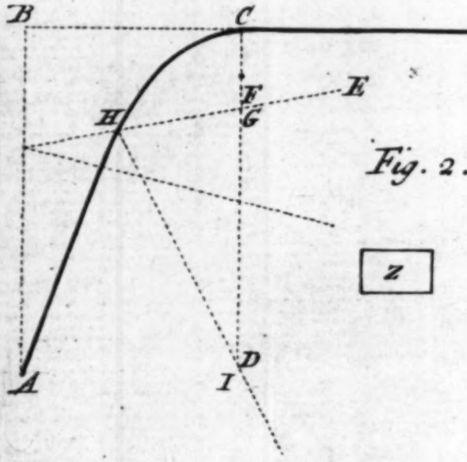
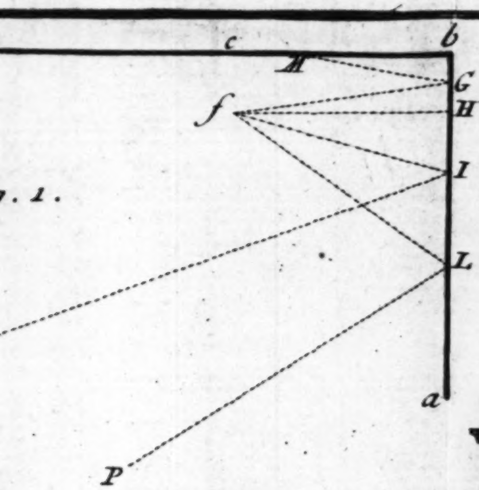


Fig. 2.

Plate I.



g. 1.

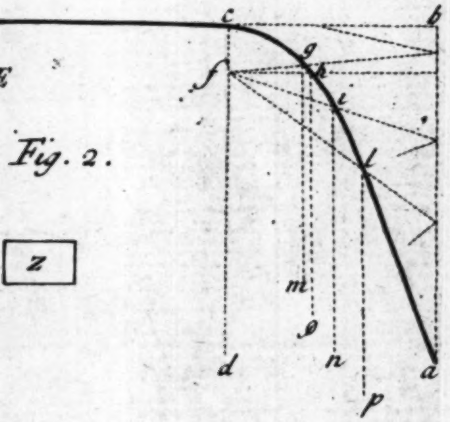


Fig. 2.

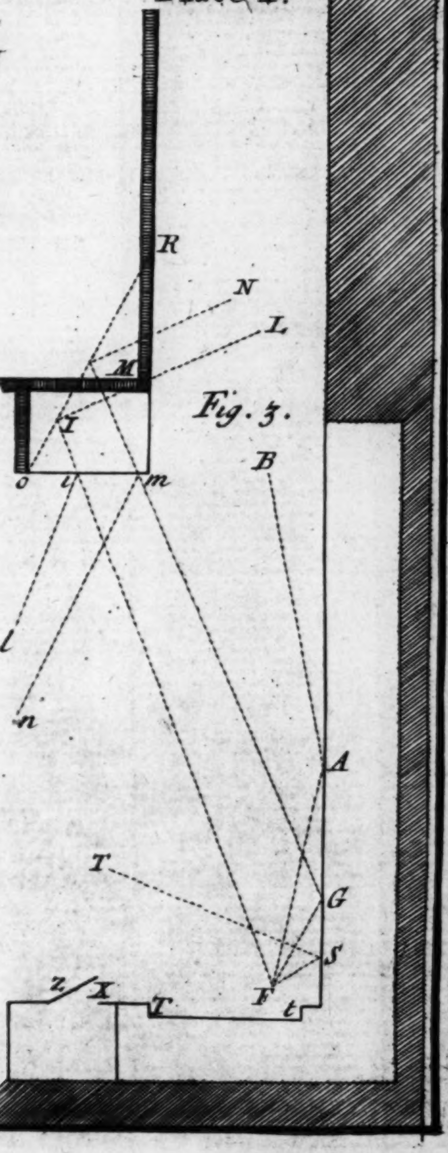


Fig. 3.

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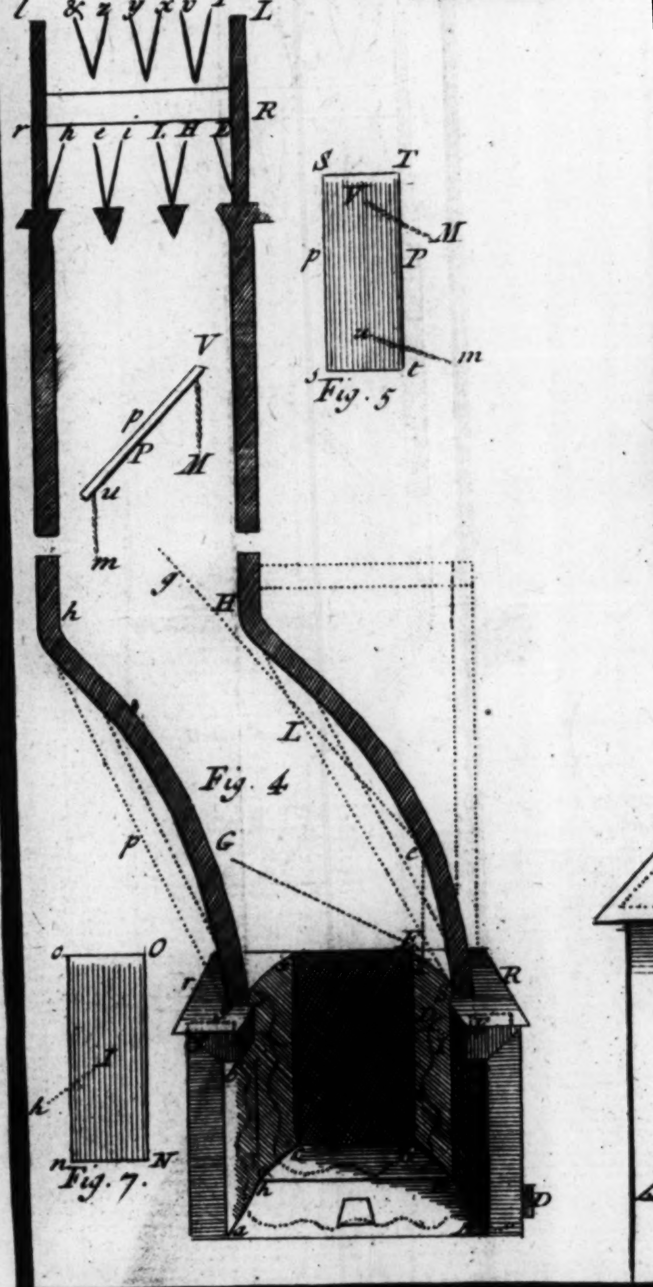


Fig. 4

Fig. 5

Fig. 7.

II.

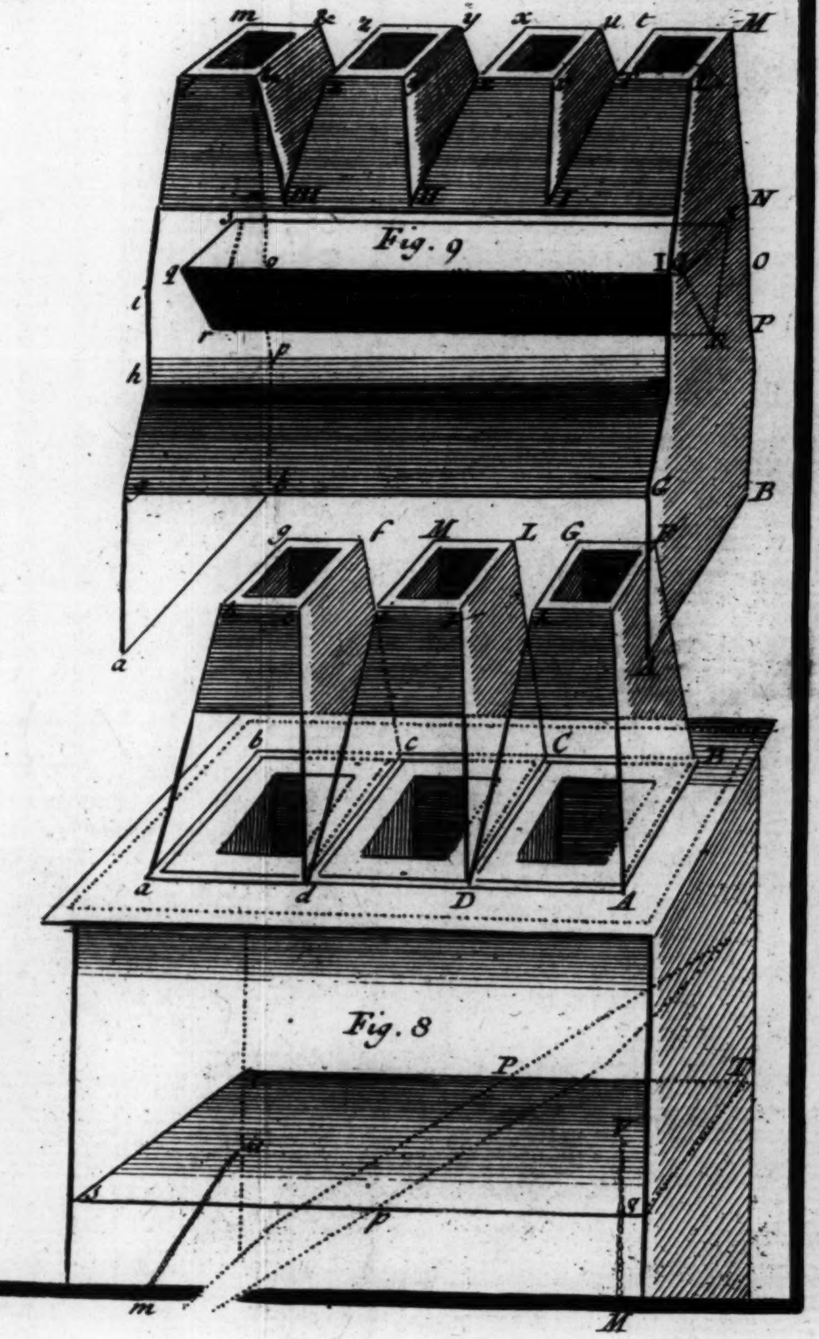
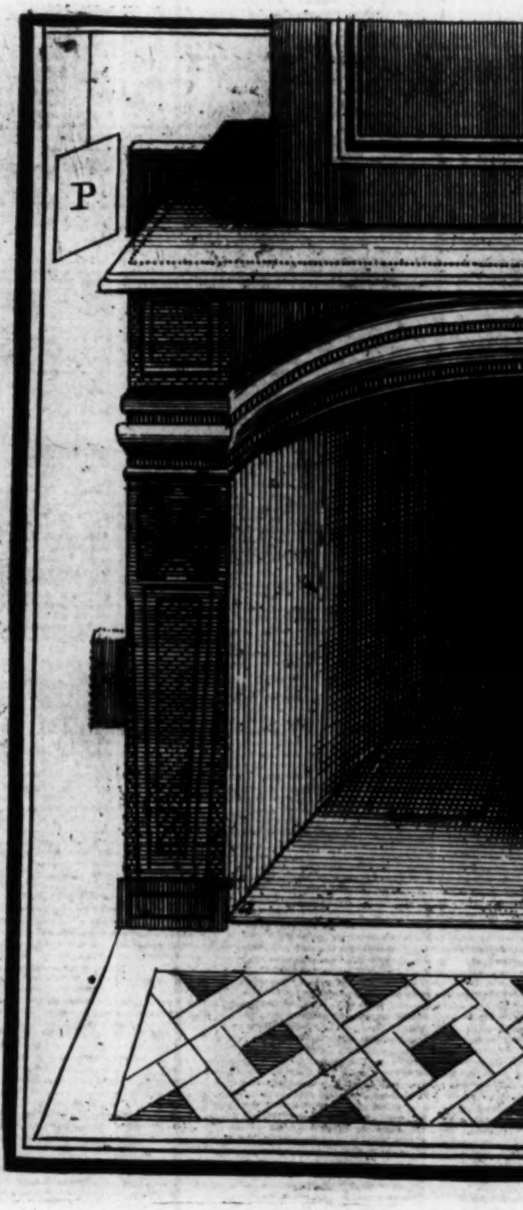


Fig. 9

Fig. 8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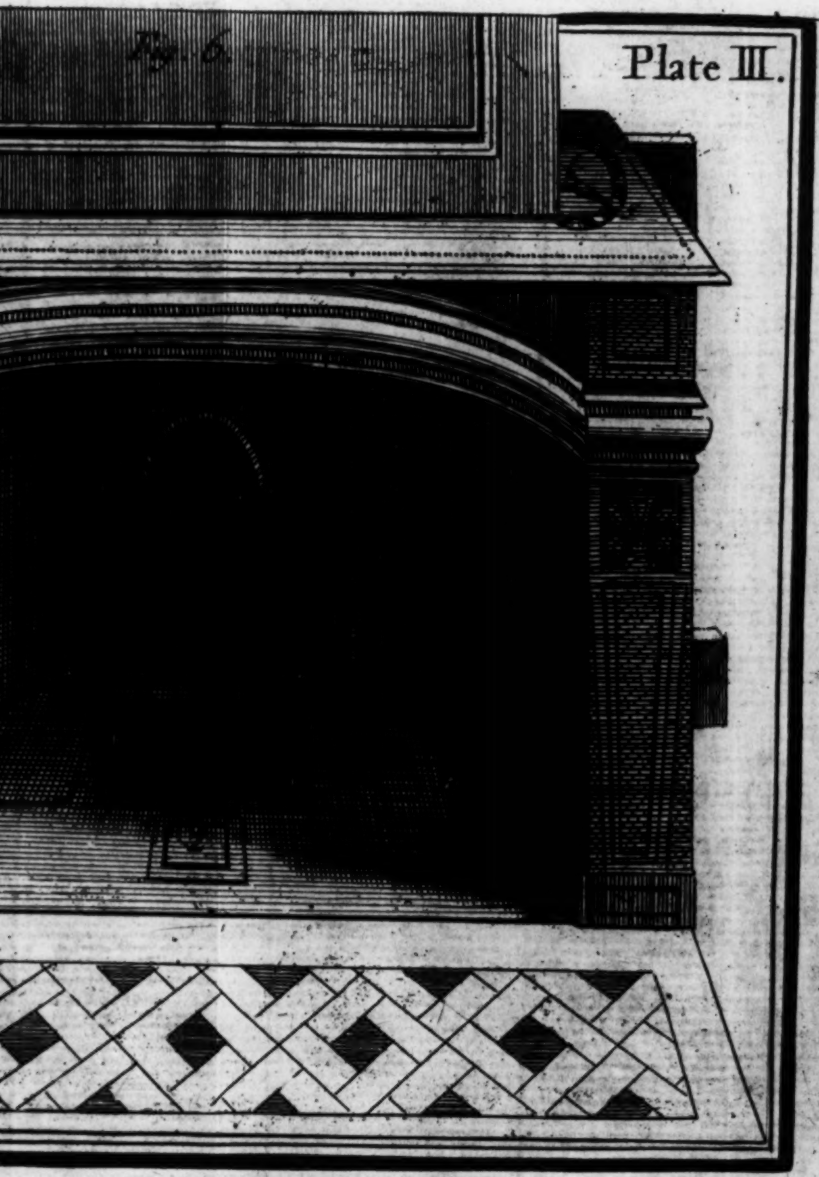

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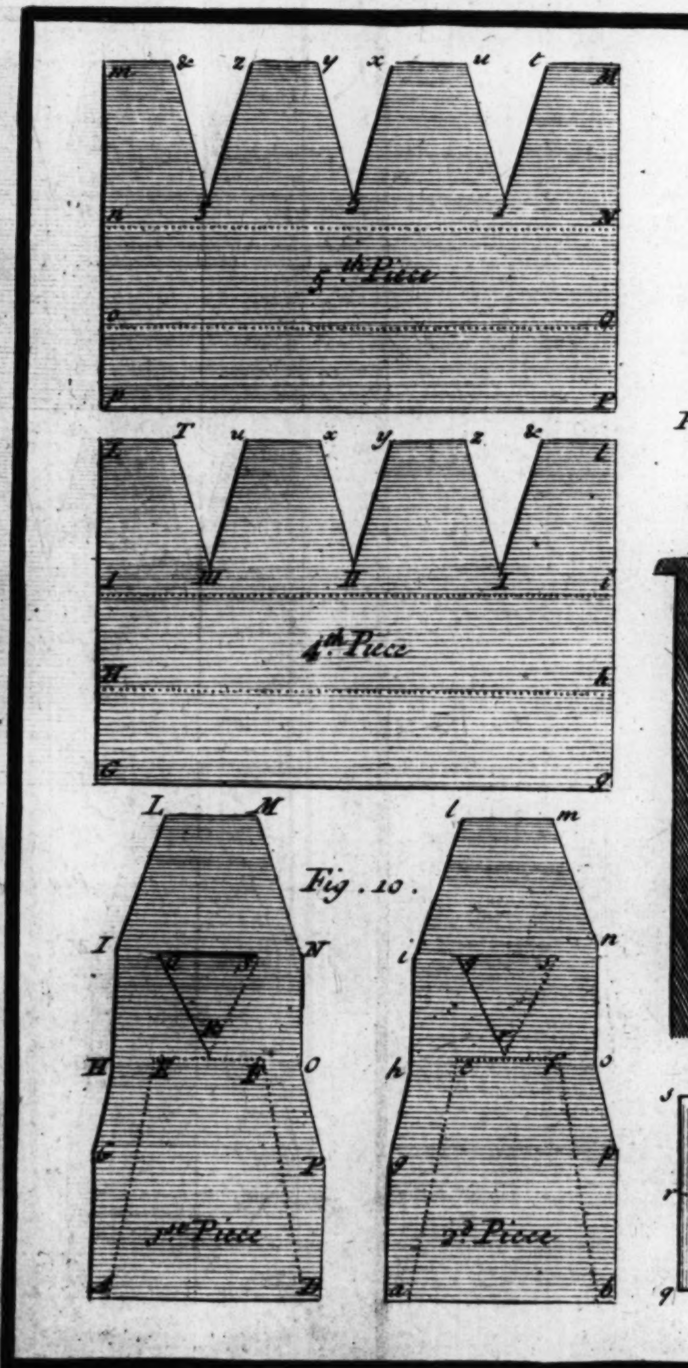
Fig. 10.
m & z y x u t M
n 3 2 1 N
5th Piece
o O
p P
L T u x y z & l
I III II I i
4th Piece
H h
G g
L M
l m
I N
i n
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h e f o
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g p
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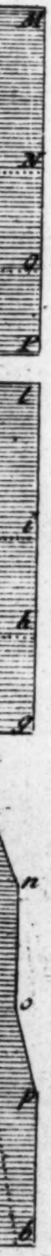
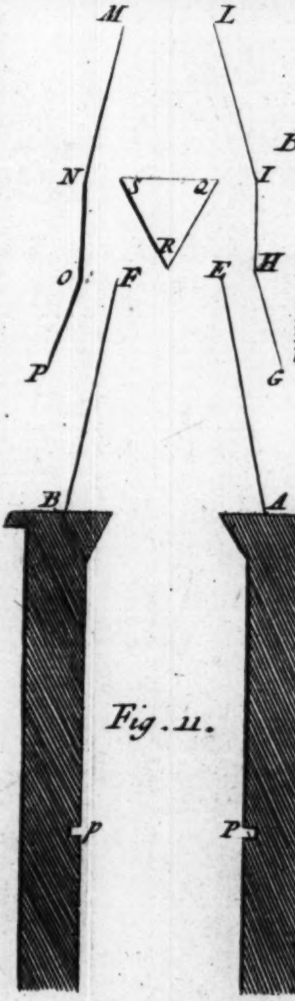
Plate IV.





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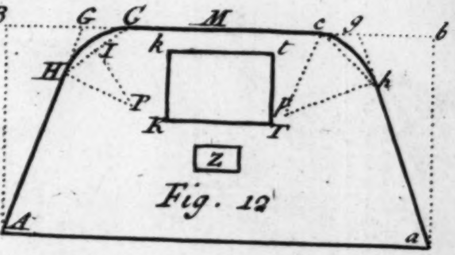

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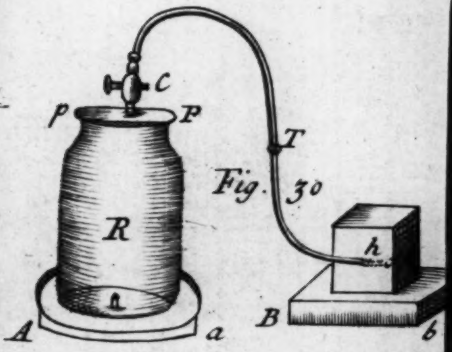

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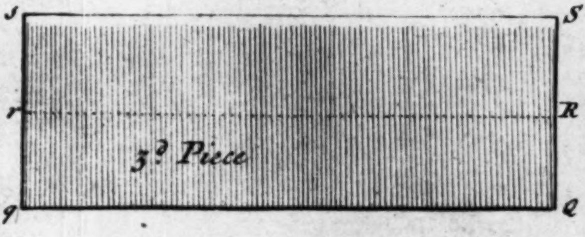

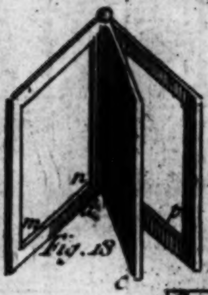
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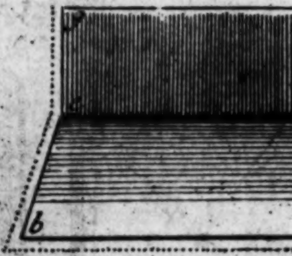

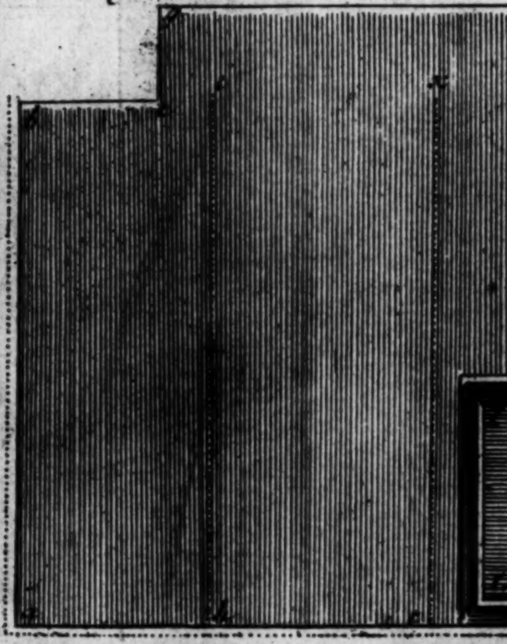

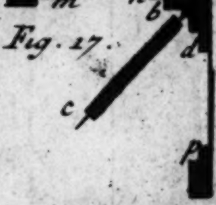
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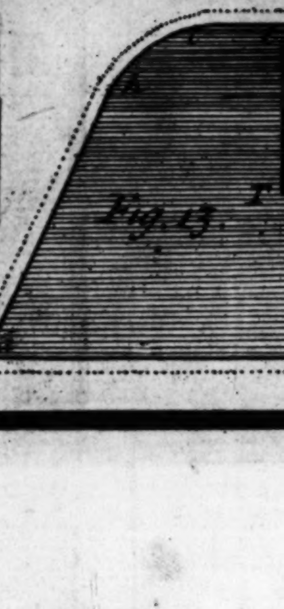
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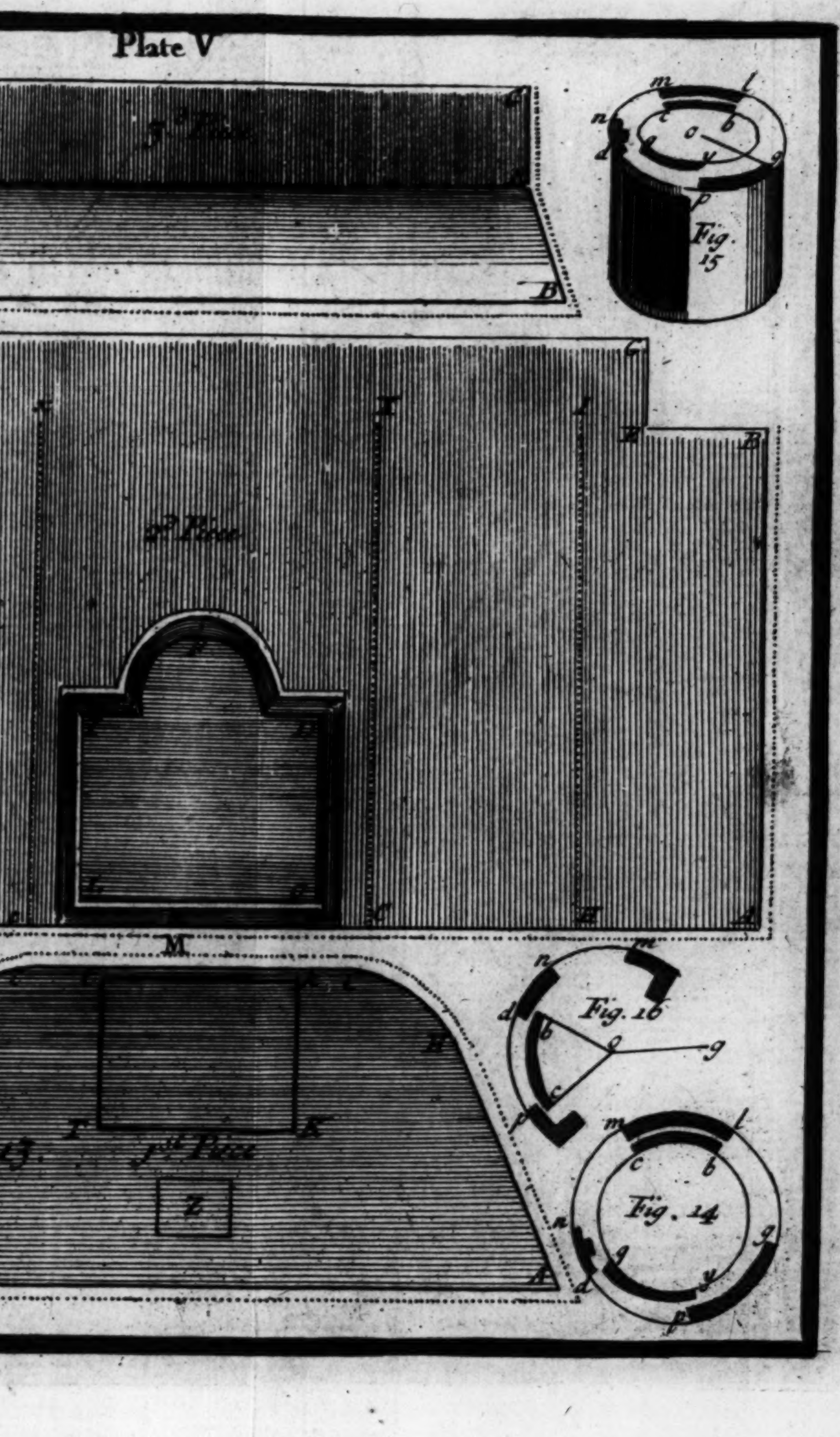

3d Piece
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Fig. 15
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Fig. 14
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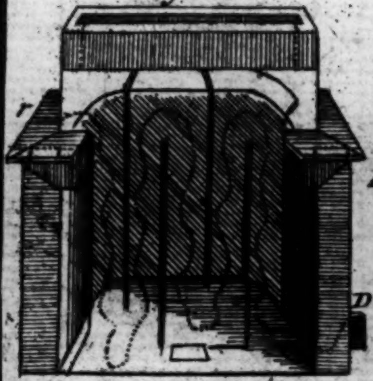
Fig. 22.



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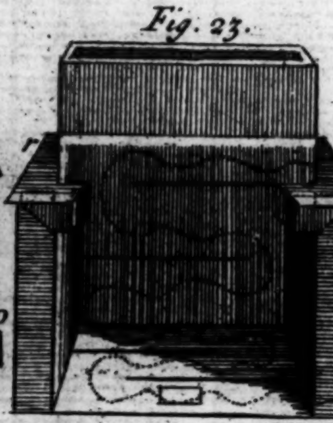

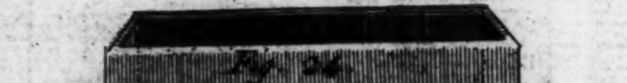
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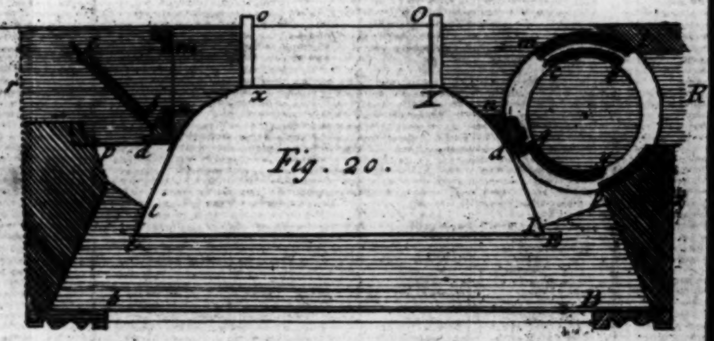
Plate VI.

3.



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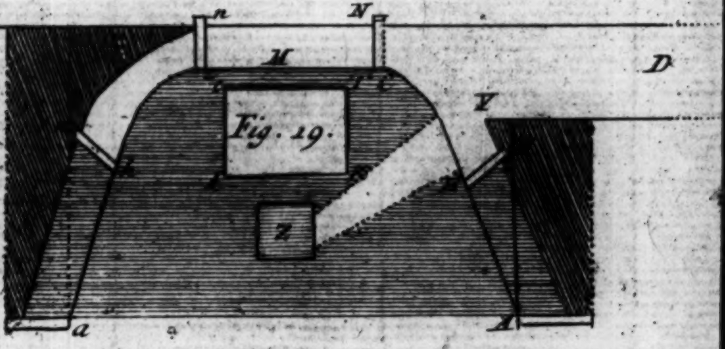

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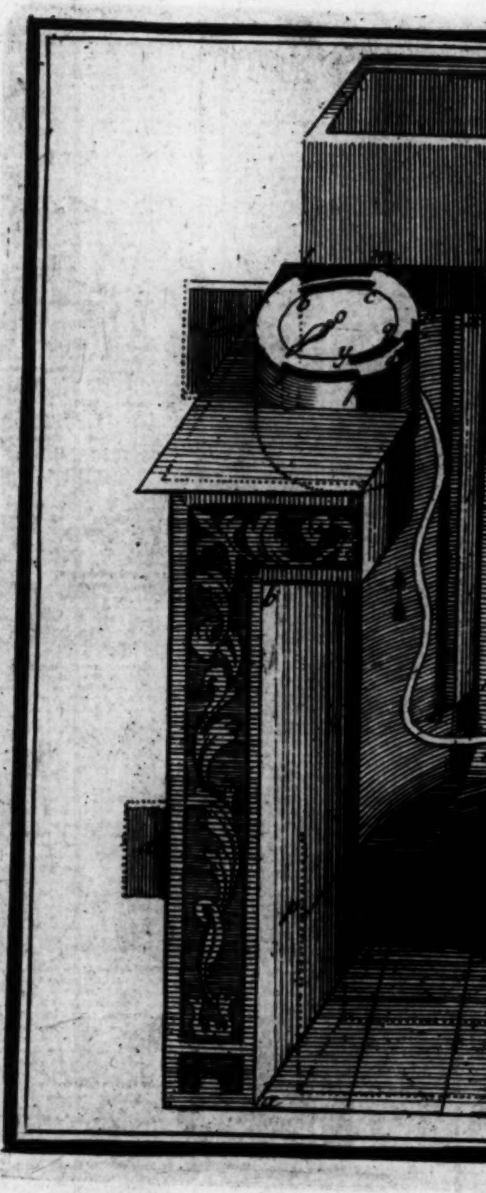
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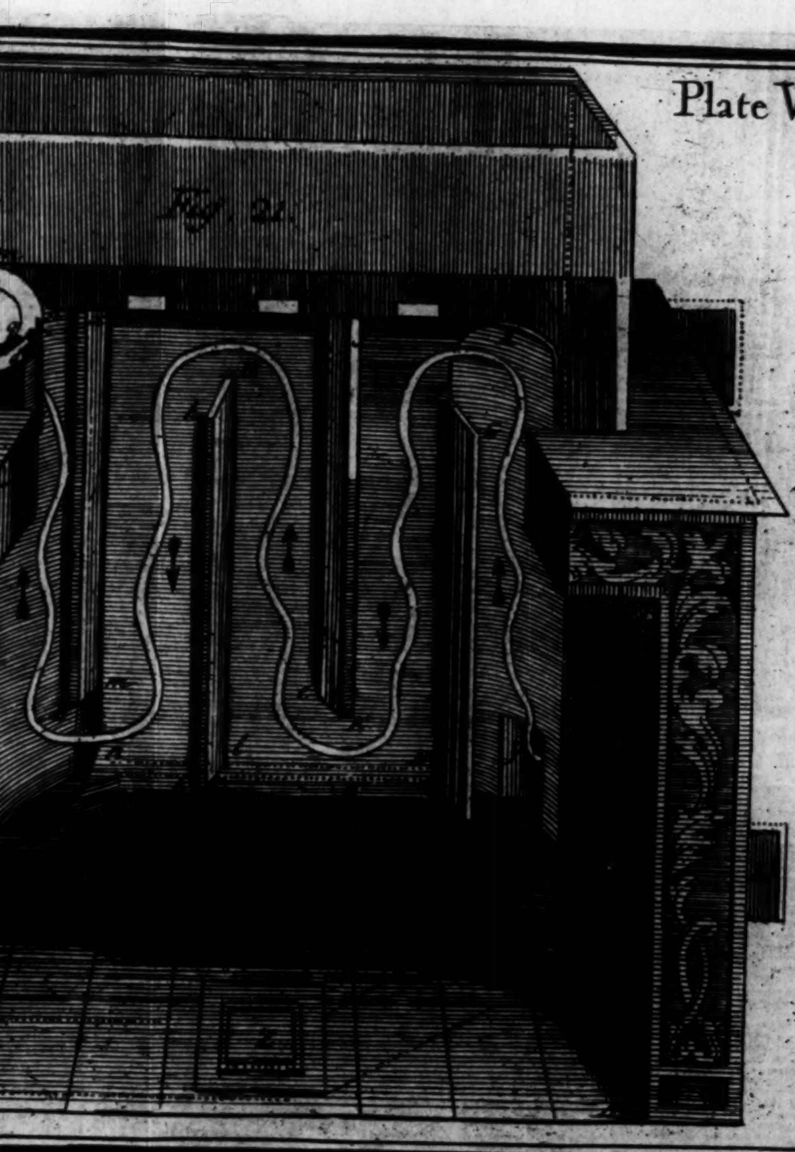
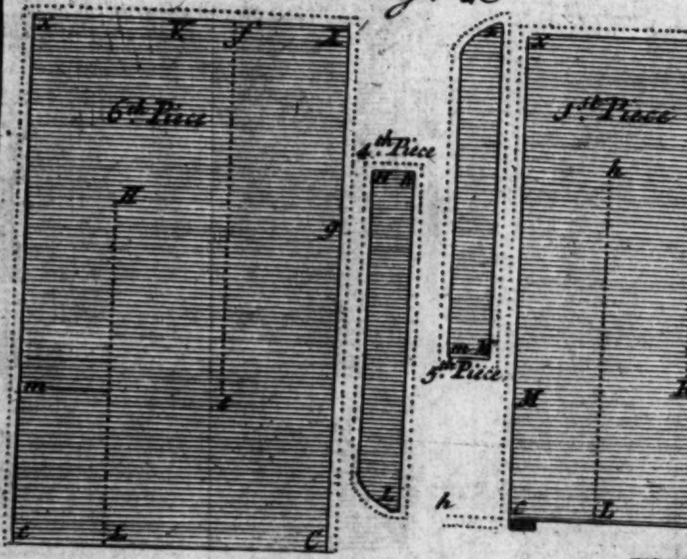


Fig. 21.

Fig. 28



6th. Piece
4th. Piece
5th. Piece
1st. Piece
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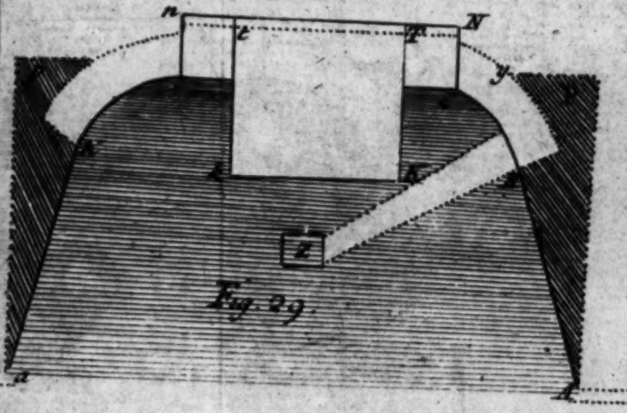

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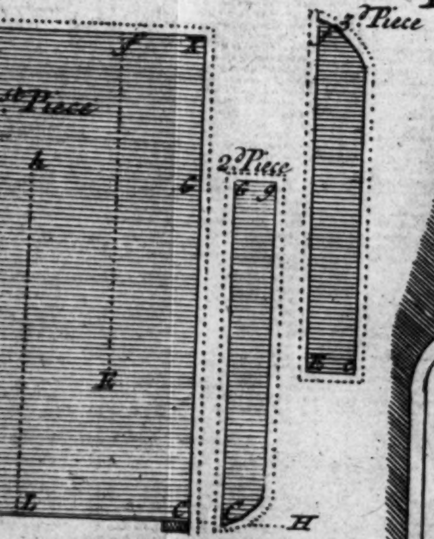
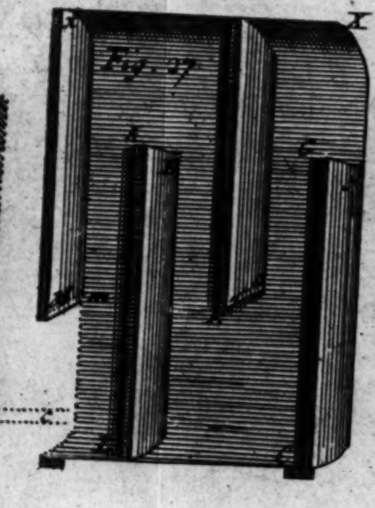
Fig. 29.

x
M

Plate VIII





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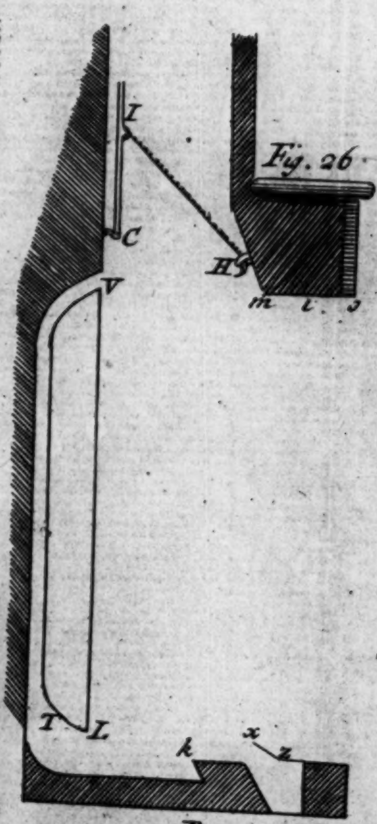

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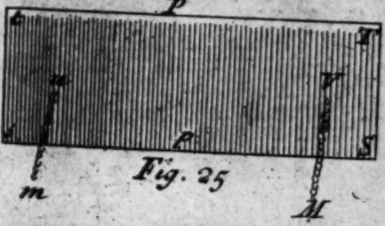
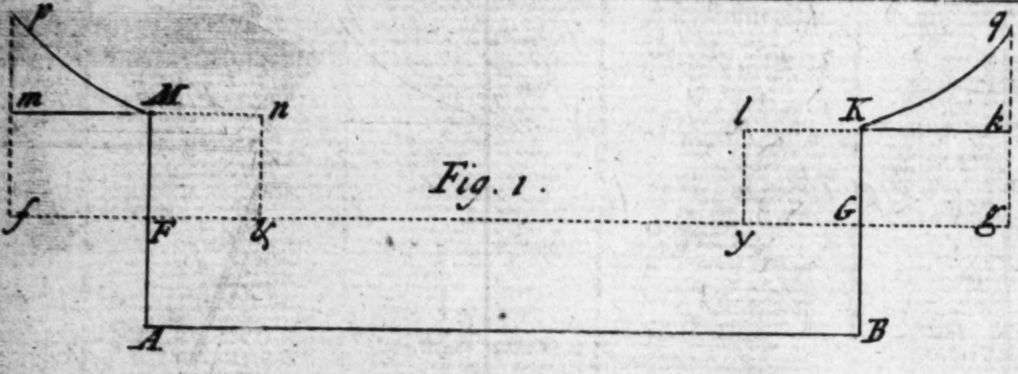


Fig. 25

Plate X.



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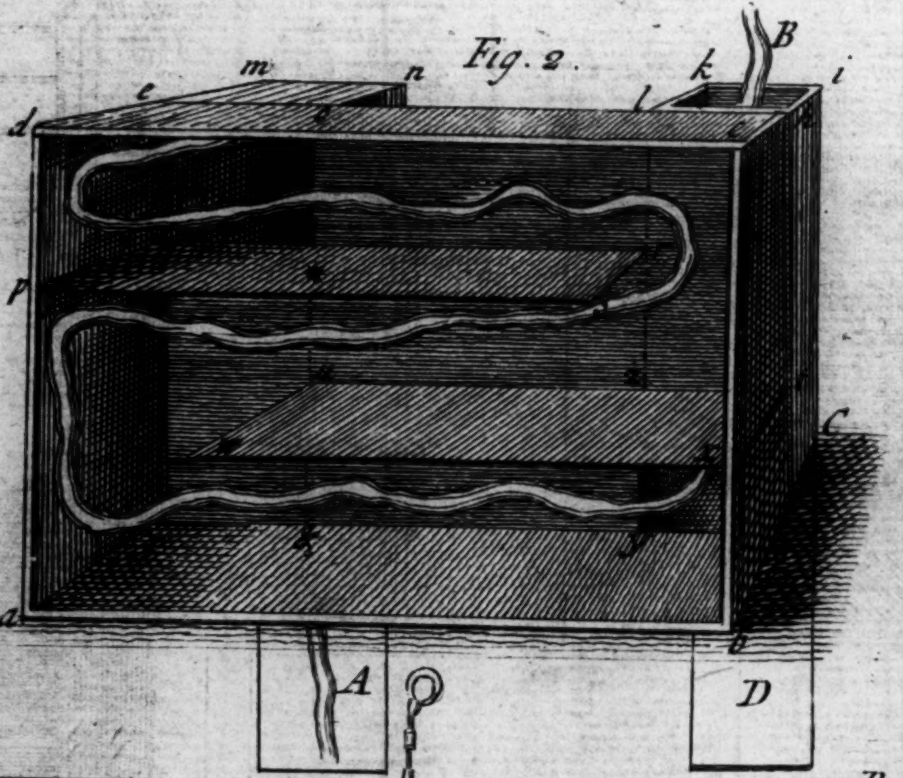

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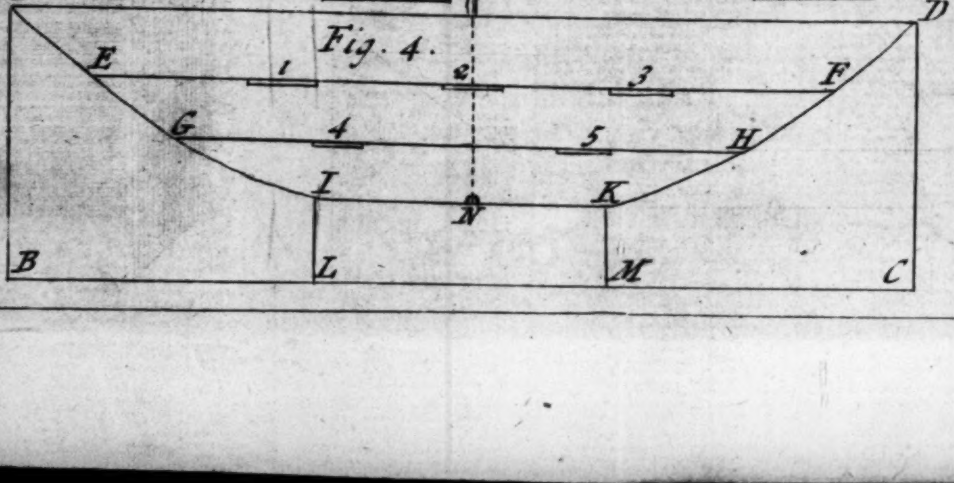

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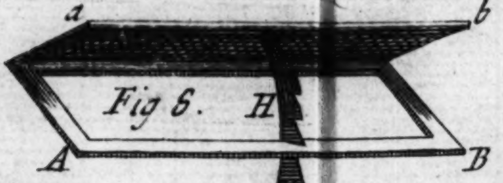
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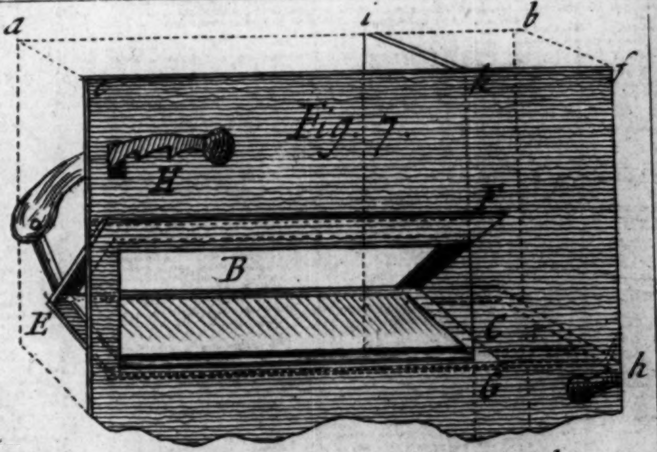
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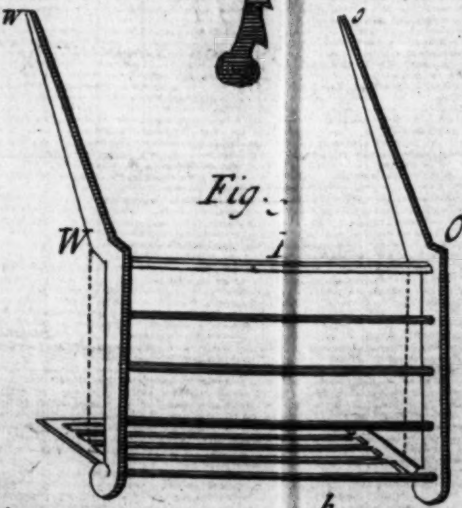
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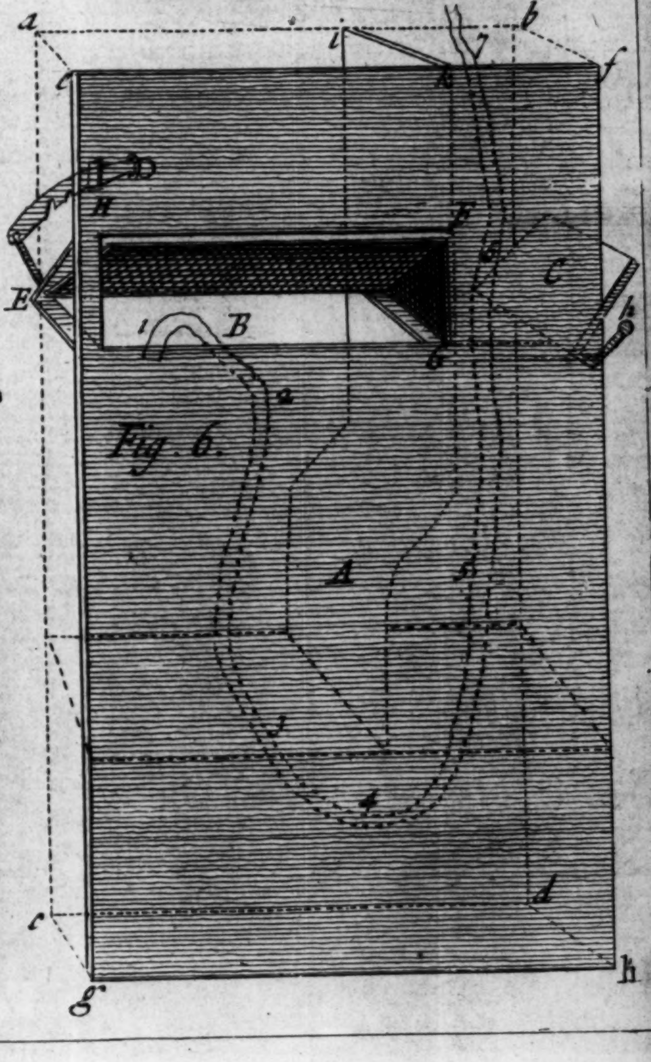
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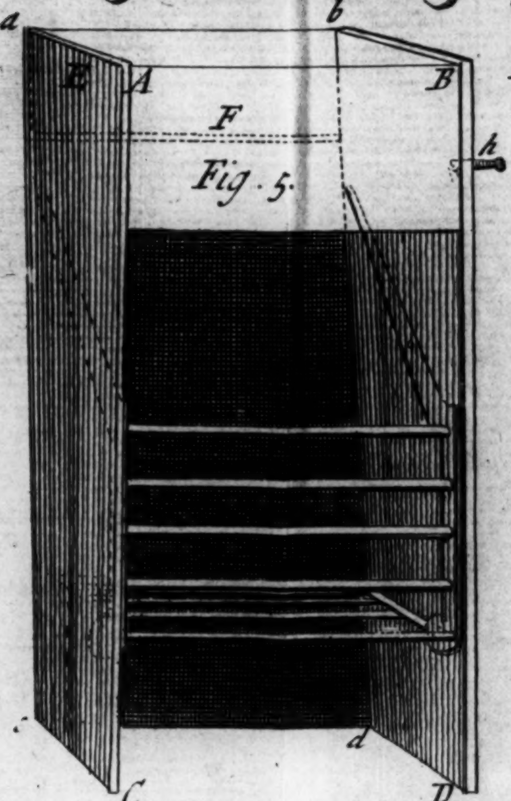
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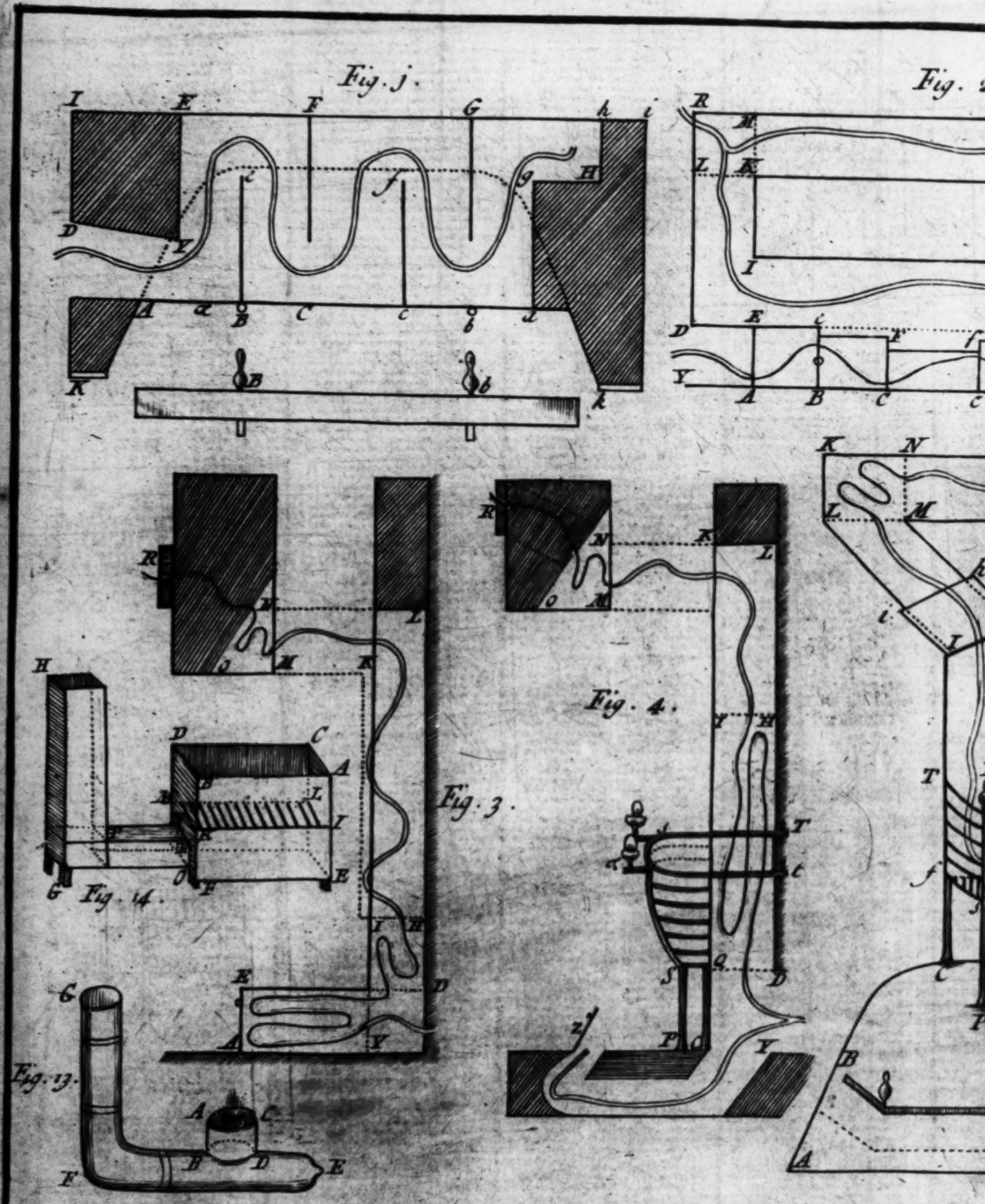


Fig. j.

Fig. 2

Fig. 3.

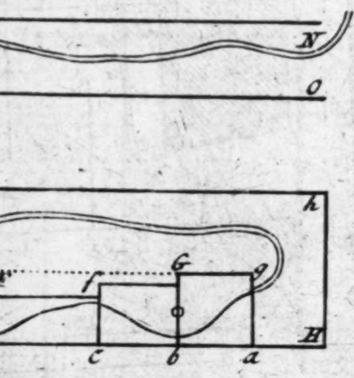
Fig. 4.

Fig. 14.

Fig. 13.

Plate IX

Fig. 2.



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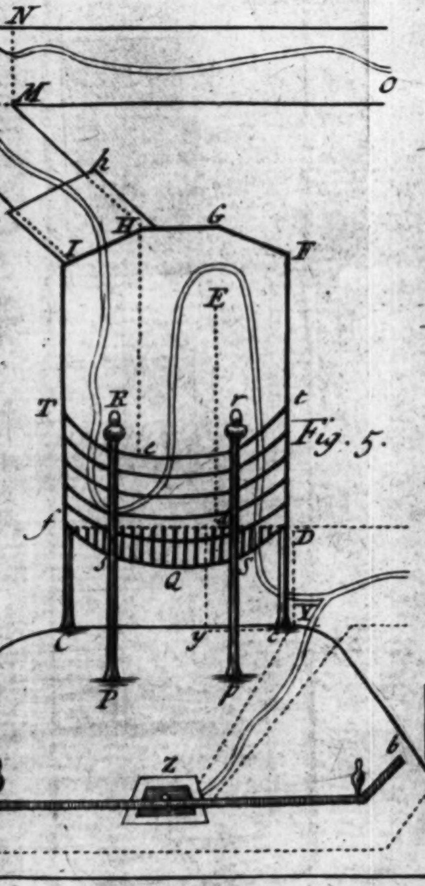
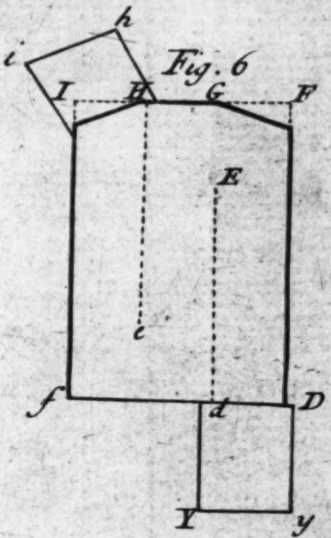


Fig. 6



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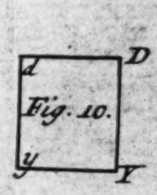

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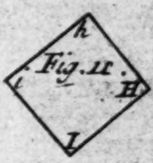

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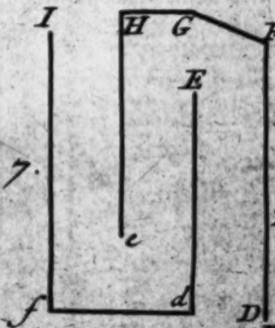

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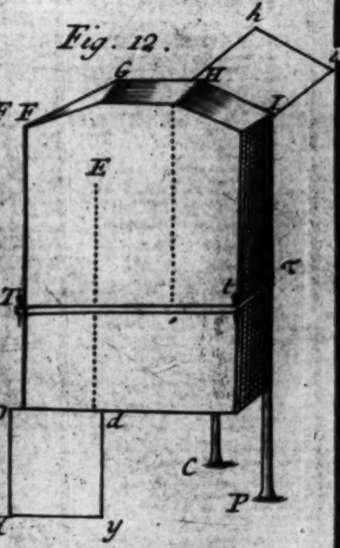

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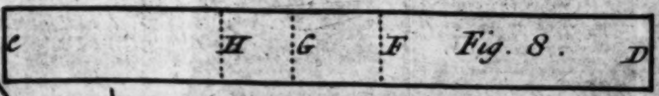

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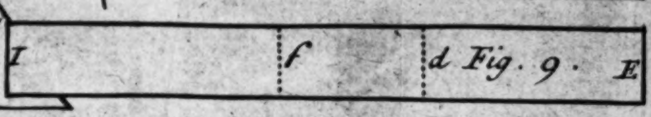

APPENDIX

By Dr. DESAGULIERS.

AFTER having publiſhed this Book, above Twenty Years ago, in *May* 1715, I made a great many Experiments upon *Coal-Fires*, and found the following *Conſtruction* the moſt advantageous.

Plate X, The Line *f* F and *y* G*g* (*Fig.*1.) repreſents the Back of the Chimney, into which you muſt cut an Hollow about 7 Inches deep, as F A B G to receive the hind Part of an Iron Box M A B K *l y* and *n*, (ſuch as is repreſented without its Back-Plate (*Fig.* 2) whoſe fore-part will ſtand out as far as M *n* and *l* K. The Cavity which receives this Box muſt be ten Inches above the Hearth, only the two Plates, which make the Returns on the fore-part at M *n* and *l* K muſt be continued below the Bottom of the Box down to the Hearth, that at M *n* to receive a Tube of 7 Inch Square abutting againſt it, and the other to be only as a Foot, and fill'd up behind with Brick-

Work. The Tube made of Plate Iron, not repreſented here, ſerves to bring in the outward Air, and has a ſeven Inch Opening in the upper Part of its End to join to, and correſpond with the ſame ſort of Opening in the Bottom of the Box, into which the Air paſſing, (when the Box is heated by the Fire, made in the Grate before it) goes thro' all the Cavities, which are five in Number, and comes out of the Box thoroughly warm'd, at the upper Part over *l* K, and ſo is convey'd into any Part of the Room in any of the Ways which have been deſcrib'd, provided its Iſſue be at leaſt as high as the top of the Box. The manner of bringing the External Air into the Box is alſo eaſy, and need not be any more explain'd.

The Chimney on each ſide of the Box, or the Spaces *f* F M *m* and G K *k* *g* may be filled up with Brick-Work, and before it may be fix'd parabolical Jams or Cheeks of Braſs, Copper, Marble or Fire-Stone, as M *p* and K *q*.

Such a Grate as is repreſented in *Fig.* 3. muſt be fix'd to the Front of the Box, by Screws, on the Wings of it, W *w* and O *o*, and its Sides W X, O Y. N. B. *If the Room be large, that you may have the more Fire, the Grate may come two or three Inches forwarder than the Front of the Box, and have one or two perpendicular Bars behind W X* and *O Y.*

The Make of the Iron Box is beſt underſtood by a View of the ſecond Figure, which is a Perſpective Drawing of the ſaid Box, ſeen from behind, when its Back is taken off, to ſhew the Cavities which are Square, and give a ſeven-Inch Paſſage every where for the Air; that is, the Section of this Square Tube is 49 Square Inches.

The white Space between the crooked Lines repreſents the Paſſage of the Air, except in ſuch of the Cavities as are hidden in the preſent Situation of the Box; namely the Perpendicular one above A, where the Air goes in firſt, riſing up to *m n*, and turning backwards horizontally towards *d*, where the Lines repreſent it; and alſo the laſt Cavity, which is likewiſe perpendicular, and receiving it behind *x*, diſcharging it at B.

o n m e d a b C *i k l o* is the Iron Box, whoſe Back-Plate is taken off at *a b c d*.

e m n o, and *l k i c* repreſent the upper Part of the Returns forward, the reſt being out of Sight.

o and *y l*, which makes the fore-part of the Box, or hind-part of the Grate, is of one Piece with the two Front Returns, whoſe upper Parts are marked *o n m* and *l k i*, and muſt be a pretty thick Plate (near a quarter of an Inch) to bear the Fire the better; but all the other Plates may be thin.

Under *e o* there is a perpendicular Partition-Plate parallel to the Plate *m n*, reaching only from *q* * to the Bottom at *l*, and that there may be an Opening from the firſt Cavity to go horizontally backwards, which is *e o q* *, whoſe loweſt Part is ſeen in this Figure.

p q r s is the firſt horizontal Partition-Plate behind the top of the Fire, ſeven Inches deficient from the End at *r s*.

x t u w is the Second, or loweſt inward horizontal Partition-Plate, deficient at *u w*, to let the Air which came over it, come under, and go in at the Hole *y g t z*, Part of which is ſeen at *y x*, up the laſt Cavity.

l h t z is a perpendicular Partition-Plate deficient at Bottom, to make the laſt Cavity *y g h l k i*, which is open at *i k l h*.

A and D are two Pieces of Plate like Feet faſten'd to the Bottoms of *m n* and *k i* the Returns of the Front Plate.

Tho' we have made the Cavities here of ſeven Inches Square, and the Diſtance *O l* of the Cheeks 17 Inches, thoſe Proportions may be alter'd, according as the Room is bigger or leſs.

There is no need of the Bellows in this Conſtruction, the Draught being very ſtrong without.

N. B. *This will cure moſt ſmoking Chimnies*; *and this Method is very uſeful for Green-Houſes, in which Exotic Plants are preſerved.*

There is another way of warming Rooms, which is very ſimple and eaſy, ſerving as well for *Wood-Fires* as for *Coal-Fires*; and of ſmall Expence. It conſiſts in contracting the Paſſage up the Chimney juſt above the Fire, when the Fire burns clear, and giving more Room when freſh Fuel is put on, or the Fire is firſt kindled. By this Means, when the Fire burns well, very little Air will paſs up the Chimney with the Smoke; but what paſſes, will move with great Swiftneſs, whilſt the reſt of the Air (which comes crouding from all Parts towards the Fire) will only be warm'd and beaten back into the Room which it will very much warm. When freſh Fuel is put on, this contracted Paſſage being too ſmall will not let all the Smoke go up, which is then increas'd; but it may be open'd wider and kept open till the Fire burns clear, when you muſt again contract it. By this Method I made the Houſe-of-Lords warm ſome Years ago. The Complaint was, that a great Fire always made the Houſe colder inſtead of warming it; by Reaſon of the great Draught of Air towards the Fire which cool'd Behind all thoſe who ſtood near enough to the Fire to warm themſelves Before; while thoſe who were farther off, only ſaw the Fire without receiving any Benefit from it, and a great Wind was made by opening any one of the Doors, when the Fire burn'd briskly. The Manner in which I cur'd it, was this: The Paſſage up the Chimney is repreſened by A B C D (Plate X. Fig. 4.) I caus'd it to be chang'd into the Figure A E G I L M K H F B, by ſetting up the parabolick Jams A E G I and B F H K, and filling up the Space A B L I. A little above the Mantle, within the Chimney, I fix'd an horizontal Plate A E F B, which has two other Plates F E H F and G I K H joyn'd to it by Hinges at 1 2 3 4 5, and ſo moveable as to turn up and lie over one another as there is occaſion to open or contract the Paſſage up the Chimney; which is done by means of a Chain faſten'd to N, and coming quite into the Room, to a Ring above the Mantle-Tree. At firſt kindling the Fire, which is of Wood, the Chain muſt be pull'd, as much as can be, and fix'd, whereby the Plates G H I K and E G H F will be lodg'd above the fix'd one A E F D, leaving the Paſſage F G I L M K H F quite open, ſo that the Smoke will freely go up. As the Fire comes to burn briskly, and the Smoke diminiſh, by means of the Ring and Chain, the Plate F G muſt be let down into its horizontal Situation; then the Paſſage left will be G I L M K H. Laſtly, when the Fire burns quite clear, let down the laſt Plate G I K H, and there will be only left the Paſſage I L M K, in which Caſe the Room is very warm. Every time that freſh Wood is put on, draw up the firſt Plate G I K H, for a little while, to let the new Smoke paſs, then let it down again. When the Fire is in good Order, if the Plates be all drawn up, by way of Experiment, one may feel the Air go up the Chimney very cold, and blowing very ſtrong, by holding ones Hand at E or F. But if the Plates be let down, ſo as to leave only the Paſſage I L M K, the Hand will feel no Wind, even tho' all the Doors be ſet open.

Mr. *Robert Phillips* (living in *Great Queen-ſtreet*, near *Lincoln's-Inn Fields*) having well conſider'd theſe two laſt Conſtructions, has, upon thoſe Principles, invented a New Grate, which he calls his MACHINE *Fire-Grate*, ſo very effectual for warming a Room, and preventing the Inconveniencies of Smoke, that I have pull'd down mine, with which I have warm'd my *Experimental Room* theſe 20 Years, to ſet up his, which I find to be better, as well as cheaper, than what I had.

Here follows the Deſcription of it. See Plate X.

The Grate of *Fig.* 3. ſtands in the Box of *Fig.* 5. whoſe fore-part is A B C D, and hind-part *a b c d*, which has an Hole E F in the upper Part of its Back, thro' which the Flame and Smoke is to paſs.

There muſt be an Hollow in the Back of the Chimney, ſuch as is repreſented by *a b c d e f g h Fig.* 6. This Hollow is cover'd with an Iron Plate *e f g h*, with an Hole H G in its upper-part, which Hole exactly anſwers to the Hole of the Grate-Box, when ſet againſt it, quite cloſe, as it muſt be in the Uſe of the Machine.

There is a bent Plate *i k* F G A *i*, fix'd edge-wiſe to the abovemention'd Plate behind it, reaching from it to the Back of the Chimney. Obſerve, that the Space behind the great Plate and Machine is always open'd upwards into the Chimney at *a b f e*, and is by the Plate *i k* A divided into two unequal Parts. There is behind the great Plate a priſmatic Frame E H F G D, with a flat Shutter, (whoſe Axis is horizontal at E D) which is mov'd by the Handle H, ſo as to ſhut the upper Side of the Frame E H F D, or the lower Part of it B, at Pleaſure; the Shutter reaching from the Wall to the Plate *e f g h*. In the Figure one may ſee the Shutter ready to ſhut the upper Paſſage H E D F, leaving open the under Paſſage B; and in that Caſe all the Flame and Smoke going thro' B muſt turn outwards, and move according to the Direction ſhewn by the doubled-prick'd Lines 1 2 3 4 5 6 7 going under the bent Plate, and turning up again thro' an Hole of four Inches at 6, which is open'd by Means of the Handle *b*, which removes the Plate C, to open a Paſſage of four Inches ſquare that way.

It is plain, that in this Caſe ſo little Air paſſes up the Chimney with the Smoke, that the greateſt part of the Air, which is warmed near the Fire, is reflected back into the Room; becauſe the Paſſage before the Grate, under and behind the Mantle-Tree, is quite ſhut up by the Frame of *Fig.* 8, which is always kept ſhut at H, except when its Shutter *a b* is open'd for a Boy to go thro', in order to ſweep the Chimney, or when you find the Room too warm, and would cool it.

At the firſt kindling the Fire, the Paſſage B of *Fig.* 6. muſt be ſhut, as is repreſented in *Fig.* 7, that the Smoke which, will then be in great Quantity, may go directly up the Chimney, and out of the Machine at *a e k i*.

N. B. Should the Chimney at any time be on Fire, it would immediately be extinguiſhed by ſhutting B and C.

The Plate fronting the Title-Page, repreſents Mr. *Phillips*'s Machine when quite finiſhed and fix'd up. N. B. *Several*

Workmen, or rather Undertakers of Work, are endeavouring to imitate this new Contrivance, making ſome Changes merely to evade the Force of his Patent; but if they make any Alterations, I dare ſay it will be for the worſe; therefore I wou'd adviſe ſuch as want to have their Rooms warmed, and Chimnies cured of Smoking, to apply directly to Mr. Phillips.

Channel-Row, *Weſtm.*
Nov. 1, 1735 J. T. D.

A DESCRIPTION *of a Fire-Place, and Chimney without Smoke, the Smoke being burnt, as deſcribed by Dr.* Boerhaave *in his Chemical Lectures.*

THE Inventor of this Inſtrument was that ingenious Artiſt *Daleſmus*, who contrived it at *Paris*, in the Year 1686, * The famous *Juſteleus* afterwards firſt publiſhed a Cut of it in the *Philoſ. Tranſ.* almoſt at the ſame Time, which is as follows. Plate 9. Fig. 13. A B C D is a hollow Cylinder made of Plates of Iron, open at both Ends, within whoſe inferiour Baſe B D there is fitted the Grate B D. This Cylinder, which is the Fire-place of the Inſtrument, is joined to the Cylindric-Tube E F G, in ſuch a manner, that there is a Communication between their Cavities. And this Tube E F G, which is of the ſame Capacity with A B C D, made of the ſame Metal, and in the ſame Manner, is open at G, and cloſe at E. If then the Tube E F G, is made very hot, and ſome live Coals are laid on the Grate B D, and over them ſome combuſtible Matter, then the Flame that is produced will deſcend into

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* See *Journal des Scavans.* 1686. pag. 116.

to the Tube E F, and paſs through F G, and all the Heat will go out at G, and the Smoke likewiſe that is generated, following the ſame Courſe through the Tube E F G, will be forced to paſs through the Flame that fills the whole Tube; and hence being acted upon by the Fire in all this Paſſage, it will loſe the Thickneſs and Diſpoſition of Smoke; will be converted into Flame, and in this form paſſing out of the Aparture G, will diſappear, without any viſible Smoke, or Soot. The famous *De la Hire* has added ſome Notes upon this Machine in the Journal above cited.

In order now ſays Dr. *Boerhaave*, ſpeaking to his Auditors, to give you an Ocular Demonſtration of the ſame Thing, I have provided this Inſtrument which is made of Plates of malliable Iron. Plate 9. Fig. 14. A B C D E F, is a hollow Veſſel conſiſting of five equal Iron Plates well ſordered together, and open only at the Top A B C D. At the Height E I within the Veſſel there is a Grate I K L M. In the ſide D F, there is an eliptic Hole N O, of the Breadth M K, and Height E I, to which is joined the Tube O G H, open at O N and H, and every where of the ſame Capacity. Pleaſe now to obſerve the Effects of this Machine. On the Grate I K, I lay ſome live Coals, that the Veſſel may grow hot, and that the Air in the Cavity of the Tube N O G P, may at the ſame time be heated likewiſe, I put ſome more on the part of the Tube N P. As ſoon as ever now the Air below the Grate, and in the Tube N O G P, grows hot, the Heat that was produced by the Coals above the Grate in the Veſſel C K is diminiſhed; and the Heat in L F below the Grate, and in the Tube N O G P, is in proportion increas'd; ſo that now you obſerve the force of the Fire, with its little Flames, tend downwards, by which a new Degree of Cold is generated above the Coals that are laid on the Grate. The Machine being thus prepared, when I lay this Straw upon the Coals, you ſee with what rapidity the Flame drives downwards through the Grate, and through all the Tube O G H, ſo that it breaks out at the top, H, without Smoke, and there produces a very great degree of Heat; whilſt at the ſame time the ſpace C K continues cold. But farther, whilſt I add *Wood*, *Turf*, *Sulphur*, and *Oils*, it proceeds exactly in the ſame Manner, and the Force of the Fire is ſo great within the Tube, that the Tube you ſee is now red hot, and the Fire burns with ſo much Fury and Rapidity, that one may hear the Noiſe that is produced by the Agitation of the Flame. You take notice too, at the ſame time, that theſe Bodies, which commonly, when they are burnt, diffuſe an intolerable Fetid, or a very agreeable Scent, now they are laid on this Fire, don't diſcover any ſmell at all, but perfectly conſume without the leaſt ſign of it, leaving nothing behind them but pure Aſhes at the bottom of the Veſſel under the Grate. All the other Parts are driven by the Force of the Air preſſing upon the Aperture of the Fire-place, into the Tube which is higher, and narrower than the Veſſel that contains the Fire; ſo that all the Flame, and the power of the Fire, exerts itſelf within the Space L F O G H; and hence, the combuſtible Parts that are reduced into a very denſe Smoke by the Action of Fire, are now carried through this pure Flame, and not into the open Air; by which means, being thus ſtrongly agitated by the violence of the Fire, even within the Fire itſelf, they are ſo attenuated in their Paſſage, that every part of them that was Combuſtible, or could be ſo divided by the Motion of the Fire, as to become perfectly imperceptible, is diſſipated into the Air, without diſcovering the leaſt Sign of any particular Quality. Smoke therefore is combuſtible Matter, exceedingly agitated, but not yet ſhining, or red hot; Flame is the very ſame Matter, only thoroughly red with Heat, and divided into very minute Particles.

FINIS.

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